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Ferranti.

IT is difficult to believe that Dr. de Ferranti is no longer with us. It is but a few weeks since we were privileged to listen to his material contribution towards the discussion on an I.E.E. paper, and marvelled at his characteristic aptitude for applying his vast experience to any problem with the freshness of outlook usually associated with youth.

This combination of imaginative vigour and mature judgment was, no doubt, responsible for the difficulty which many had in forming an estimate of his age. Dr. S. Z. de Ferranti—or, to use the shortened name under which he has for long been sure of immortality, Ferranti—had become so much of the weft of electrical history that surprise was often expressed that his appearance and faculties were those of a man much younger than would seem possible to a generation without knowledge of the early ripening of his genius. His accomplishments from before his early teens until the age of 65 have meant a continuous contribution for more than half a century of an enormous volume of research and practice, scientific and industrial. Kelvin attained four-score years and was engaged on practical contributions to the scientific progress of the race right to the last. Where might not Ferranti have led us had he lived so long?

We do not propose here to attempt an appreciation of Ferranti's position in the world of electrical science; that is done elsewhere in this issue by one whose qualification to do so is probably unique. We do, however, wish to take this opportunity of expressing what Ferranti means to a later generation. Great as were his works as an inventor and a constructor, they have become a part of the civilisation in which men with whom the future lies have been reared; they are accepted as a part of the established order. It is the loss of his leadership as a trusted seer and practical visionary that is irreparable.

In the pioneering stage of the electrical industry, Ferranti found enormous scope for his powers of improvisation, but his interest did not stop with the complete utilisation of opportunities for making things; he desired to ensure that they produced the greatest

effect in practice in the widest sense. His support was readily given to every movement that helped towards the electric age, and his counsel was freely given to those who sincerely worked for the progress of the industry. Thus, he foresaw the potentialities of the supply of electricity for domestic purposes, and recognised the importance of the part that the Electrical Association for Women was destined to play in bringing electricity into the home. It is appropriate to remember, too, that Ferranti's last public office was as president of the British Electrical Development Association.

Of immortality on earth there are two kinds. One is the immortality due to the works their author leaves behind him as a common heritage; the other lies in the inspiration of those who come after to work on in the faith. The " Ferranti faith " will, we believe, prove as potent in electrical progress as the works of the great engineer. As an example of how this faith has inspired others, we may quote from our leading columns when commenting upon his presidential address to the Institution in 1910: " Mr. Ferranti has led the way before; he leads again, and we confidently accept his guidance; we must all look ahead—and go ahead."

The Winter Peak.

AN article is published in this issue describing the method of constructing graphic load curves in use on the system of the company supplying electricity in British Columbia. Although the method is not new and is, in fact, in use in several British undertakings, there is reason to believe that its merits are not so widely recognised as they should be. From the particulars given it will be seen that the winter peak occurs in British Columbia at 6 p.m.—more than an hour later than is usually the case in this country—and thus presumably avoids the lighting and power " overlap," which fixes the year's maximum demand of most of our undertakings.

Meter Readers and Service.

THERE is much to be said for the suggestion by Mr. Edward Cross, M.I.E.E., the engineer and manager of the Rotherham electricity supply undertaking, which we deal with in our " Electricity for the Home " Section in this issue, that a great deal might be done in extending domestic electrification by increasing the usefulness of meter inspectors, by way of advising consumers on electrical matters and also carrying out small repairs.

In the usual way the meter reader is probably the only supply man whom the consumer gets to know; indeed, he is in a favourably unique position to effect a valuable liaison between the supply undertaking and the consumer.

The problem involves, of course, slightly raising the status of meter men, and of giving more consideration to the type of man employed. To put such a scheme into operation would no doubt necessitate some " weeding out " among existing staffs, but much might be done by way of instructional lectures to existing meter readers on such subjects as salesmanship, business etiquette, &c.

There is another important consideration bearing on the proposal, that of avoiding misleading advice being given to consumers by irresponsible meter readers. We have heard of the actual misrepresentation of facts by consumers as the result of conversations with meter men, and it is difficult to over-estimate the harm which might be done to the supply undertaking in such cases. The facts are that consumers *will* take their troubles to the meter man, and the latter *will*, indeed *must*, talk. The man who can avoid saying the wrong thing is the man who is capable of saying the right thing.

We believe that the Rotherham engineer's suggestion and intention is one that will prove, in fact has proved, itself to be a progressive move, and we seriously commend the idea to other undertakings.

Our Overseas Electrical Trade.

AT successive meetings of electrical manufacturing companies the great importance of foreign and Dominion markets has been stressed by the chairmen. It is impossible for the home market to absorb more than about half of the products of the industry, judging by figures which have been quoted from time to time, and, therefore, if the works are to be kept running at anything like capacity, outlets must be found for goods in the markets of the world.

It is for this reason that we give so much attention to the Board of Trade returns, which provide the only comprehensive survey available of the general trend of overseas electrical trade. In this issue we reproduce the December figures, and with them the figures for the whole of the past year. Judging by the export figures alone the trade would appear to be almost stationary; the increase during the year was only about 6.6 per cent. Looking further it is found that imports rose by 30 per cent., and it might be assumed that, instead of buying British goods, purchasers were looking abroad for the satisfaction of their requirements.

The British electrical industry is not, however, in a bad way; in fact it is still one of the bright spots in the drab industrial picture. We are led to conclude, therefore, that electrical development in this country is going ahead so fast that the position is changing, that is, the proportion of electrical products which are being sent abroad is becoming smaller, while home consumption is increasing. It is reasonable to assume this in view of the growth in the import trade, but that is no reason why that trade should not be replaced to a great extent by British products.

Domestic Hot-water Supply.

A USEFUL survey of the subject of domestic water-heating by electricity was made by Mr. C. Hubert Smith at last week's E.D.A. Salesmanship Conference. From the report which appears in this issue, it will be gathered that the matter is a complicated one. It is not merely a question of installing a water-heater or placing an immersion heater in an existing tank. It is this " simplification " which has led to trouble in many cases in the past. Electric water heating requires scientific consideration if efficient and economical results are to be obtained.

The cost of energy is a handicap in, perhaps, the majority of towns, but it is one that is rapidly diminishing as more and more undertakings reach or approach the " point five " rate. The speakers at the conference seemed to be confident that a halfpenny rate was quite satisfactory. We recommend the paper particularly to supply engineers, upon whom the future of water-heating largely depends. The field is an enormous one, for very few houses have a really satisfactory summer and winter hot-water supply system.

Argentina's Electrical Progress.

WE do not apologise for publishing particulars in this issue of Argentina's electrical import trade during 1927. The figures have certainly been long delayed—for that the Argentine Customs authorities must be blamed—but they afford the only available indication of the trend of the trade and as such must be given attention. The position disclosed by the statistics is not favourable to this country. Although the total trade increased by about 2,700,000 gold pesos, the share of the United Kingdom declined by approximately 1,800,000 gold pesos, mainly in favour of the United States and Germany. The proximity of the United States and the cheapness of German goods appear to be the principal handicaps to our trade. They are, however, obstacles which are not absolutely insurmountable, and continued effort, study of the market, and efficient trading methods should bear fruit. A short article which follows the trade figures paints a glowing picture of Argentina's electrical future. Progress is expected to be far more rapid than in " effete " Europe and outlets for electrical goods should increase and multiply.

Ferranti and his Work.

By LLEWELYN B. ATKINSON, M.I.E.E.*

ON January 13th of this year Sebastian Ziani de Ferranti passed away and so the world has lost a great pioneer and a great inventor, and the electrical world has lost a leader and a master of its art and craft. To the world, even the educated world, the name of Ferranti means little, something they have seen on some machines or apparatus which helped to make their lives easier or more convenient, but to electrical men, and perhaps especially those of the earlier days, the fact that this clear and synthetic mind will no longer lead us, the fact that this delightful and charming personality has gone, leaves us feeling that a dark shadow broods over all we do and think. And the tragic suddenness of it! It was only on December 19th that he was in our midst at the Institution of Electrical Engineers leading the discussion on Mr. T. G. N. Haldane's paper on an electrical heat pump, telling us how so long ago as 1887 he had discussed with Lord Kelvin the possibility of realising this type of apparatus. How full of zest, how full of recognition for what the author had realised; little did the audience then, or those whom he joined at dinner later, realise that this young man, as Ferranti always seemed, had said his last say to his comrades in the world of electrical engineering, to which he had devoted nearly the whole of his life's work. To many electrical engineers of the younger generation Ferranti's name rests on the appeal which he made when he was president of the I.E.E. in 1910, for the recognition of the universal application of electricity for all purposes, for its adaptation and substitution for all other forms of energy, whether for heat, light, or motive power, on his persistent reiteration of this idea, and on the work which he, personally, put into its furtherance in later years. The lack of knowledge and recognition of his other work arises largely from his great reserve and modesty as to his own achievements, and so it is perhaps well that we should try and measure the results as he has left them in the various directions where he made great advances by his wonderful vision and inventive genius.

Lafayette [*London.*

The late Dr. S. Z. de Ferranti, F.R.S., Hon.M.I.E.E. Faraday Medallist.

Ferranti was first and foremost an inventor, not an inventor in the sense we use the term sometimes of an individual with some single idea in his mind which becomes gradually a mania, but a thinker who has studied and absorbed wide fields of scientific knowledge, so that when a problem is presented the problem can be analysed, and from the fundamentals disclosed by such analysis a synthesis can be produced, bringing into play the elements derived from the accumulated data of science, thus enabling the required result to be obtained. But in some of Ferranti's work, particularly his electrical work, he had to be a discoverer of scientific fact as well. Furthermore, it happened that in the case of so technical a subject as electrical work, so full of new and generally unknown problems, Ferranti had to be his own salesman, and throughout he had to teach other engineers his ideas, to train helpers and workers to carry them out, and this frequently among the appalling difficulties of the finance of new and untried undertakings. From 1882 till the end these are the tasks he has grappled with, times of brilliant success, times when others would have despaired, always retaining his own balanced serenity, his splendid confidence in himself and his work, the best at the most difficult hour and the most difficult task, ever conveying his wonderful and youthful enthusiasm to others and inspiring loyal colleagues to work with him for love of him more than for thought of reward.

For all this he was preparing himself before he could be considered a schoolboy, and he had taught himself the elements of some of the sciences, and had constructed a galvanic battery and an arc light before he went to school. He was at a school where we have no record of science training, but where he constructed a dynamo when very few existed. He was for a very brief period at University College but not a student taking a regular training course. What he knew he learned by his own study of what others had done, and by finding out for himself what others could not tell him. In 1882, being then 18 years of age, when he had had a certain small amount of electrical training in the works of Crompton & Co. and Siemens, he took out his first patent, which was for a dynamo, and from that time onwards a stream of new ideas, new constructions, new developments, came from that wonderful mind.

Ferranti's work seems to divide itself into three principle phases, though these were never completely separated. These were: (1) generation and distribution of electricity—chief period 1882-1905—and from about 1911 onwards missionary work, both by word and practice, in the universal application of electricity for all the energy wants of mankind, and the conversions of all sources of energy into electrical energy for this purpose; (2) the turbine engine (1895-1930), eventually the gas turbine, but as an intermediate stage the steam turbine, as the means of converting heat energy into motive power and so of developing electric energy; (3) the improvement and speeding up of textile spinning, particularly

* The author desires to express his great indebtedness to past and present colleagues of the late Dr. Ferranti for great assistance given, by documents and otherwise, enabling him to correctly fix dates, facts, and gaps in his own personal knowledge.

cotton thread spinning, on which he has worked for 27 years and was working up to the time of his death. These do not cover all the fields of his work, others will be mentioned, but these are worth study.

His electrical inventions began with the alternating current dynamo patented in 1882, which being exhibited in 1883 created at once an enormous interest among electrical men and engineers as well as in the Press. The time was ripe—1881 had seen the streets of London lighted electrically, and all kinds of dynamos were coming on the market—when Ferranti appeared with his machine, with an output greatly ahead of anything existing for the size and weight, so much so that even one of the technical papers stated that the figures given " must be taken with a grain of salt." It is generally thought that Ferranti's invention consisted in the zig-zag winding of the revolting armature of this machine, but he himself states at the commencement of his specification that Sir Wm. Thomson and Dr. Hopkinson had proposed this construction; the general outline of the machine was that of the then existing Siemens alternator, but the departures were fundamental in this, that the design embodied a much heavier field magnet system relative to the armature, and the construction of the armature definitely established a dynamical rigidity due to the centrifugal forces, so that contrary to constructions up to then the faster it was run the stronger it became. The mechanical construction was at the time wonderful, and was a foretaste of the extraordinary mechanical fitness which characterised all his work.

In 1883 Ferranti made his first mercury meter in which mercury, through which the current to be measured travelled radially, was placed in a magnetic field, the speed of rotation of the mercury being approximately proportional to the current passing through it, and the motion of the mercury actuating a train of counting wheels recorded the consumption. With variants in mechanical construction and in the methods of " braking " this type of meter has existed ever since. The first of such meters was installed in Sir Wm. Preece's house in Wimbledon. The arrival in London in 1883 of the Gaulard and Gibbs system, with transformers worked by constant current, directed Ferranti's attention to the question of transformers, and in 1885 he patented his well-known transformer, where lathe wound coils were cored with iron strips, which were bent over at the outside and interleaved, the whole being mounted in a frame. The experimental work on these transformers was carried out on an installation at Messrs. Whiteleys, where the Ferranti alternator was at work, and Ferranti had in 1885-6 demonstrated completely the fact that a transformer whose primary was fed at constant voltage, gave an approximately constant voltage in the secondary, an invention arrived at quite independently by Zipernowski and Blathy in Hungary.

In 1885 Sir Coutts Lindsay had established a central station at the Grosvenor Gallery, supplying customers by Gaulard and Gibbs transformers. Great difficulties were being experienced with the system. Ferranti being informed of the difficulty with the distribution system demonstrated to the directors his parallel system of transformers. He was appointed engineer to this company, and on January 13th, 1886 (forty-four years exactly before the day of his death) he took over the charge of the Grosvenor Gallery central station, with C. P. Sparks as his station engineer. The story of the early days there, of the foundation of the great Deptford undertaking, the prototype of all modern generating stations, has often been told, but however often it is told one cannot help once again picturing it.

Ferranti consulting engineer to invent and design everything for a great untried system as a whole, working at a pressure at least 20 times as high as there was then any experience of; Ferranti owning a works and manufacturing nearly everything that was wanted because there was no other source; Ferranti managing the first long-distance transmission and distribution business in the world; and he was 23 years of age, an age when many youths are still being educated. A million and a quarter pounds placed by some of the shrewdest financiers in the City in the hands of this untried young engineer to solve a problem quite unknown! In 1891 Mr. Staats Forbes, the chairman of the company, stated: " I do not know any man who during the last year has had a more terrible responsibility upon his back than Mr. Ferranti. He pledged his reputation, his fortune, his labour—day and night—to achieve the result he promised to the directors."

But he won through, and before he was 28 years of age had given the world the general solution of electrical power generation and distribution by high voltage.

In 1891 the Deptford station was running and the Grosvenor Gallery was a sub-station, but the switching gear was incomplete, and when a switching accident caused a disastrous fire everyone was in despair. The supply failed completely for months. Ferranti and his partners were faced with a lawsuit by the company, and ruin seemed to face them. Ferranti and his co-workers, however, faced the crisis, new sub-stations were built, and the enterprise saved. Before this, however, the 1888 Electric Lighting Act had altered the whole aspect of the supply of electricity to London; the Deptford station, originally designed to supply all London, was limited to a part only, with the result that the 10,000-h.p. direct-driven alternators were never completed, and smaller ones were installed. It may be noted here that Ferranti had from the first proceeded with his high-tension work with one main earthed, and all his early dynamos had one pole earthed, entirely contrary to the views of all electrical engineers at that time.

Returning to the story of Ferranti's work, his manufacturing activities may be summarised. The early manufacturing of Ferranti's dynamos was done by the Hammond Co. at Appold Street, Finsbury. Then after the collapse of that company, Ferranti had a workshop on a top floor in Hatton Garden where the meters were made; then, in 1887, a building in Charterhouse Square was taken as a works, the firm then being Ferranti, Ince and Sparks. It was here that meters on a considerable scale, dynamos, transformers, oil break switches, and oil break fuses were made, all of them Ferranti's own conceptions and designs. It was here that in 1887-8 the first 10,000-volt transformers were made. Ferranti during this period made three important contributions to the cable art. In 1885 he had devised a concentric conductor which was made of one copper tube within the other with insulation between, the lengths being jointed by a plug forced into the butting ends, whilst a length of copper tube was forced over the two outer tubes, making the joint. In 1889, when the 10,000-volt mains were to be laid, he invented the system of insulating this type of conductor by ozokerite impregnated paper, and the paper-insulated cable was born. The production of this conductor was another instance of Ferranti's genius in design and mechanical manipulation; the tubes slipped over one another were drawn down by dies to a tight fit, the internal tapered plugs forced in to intimate mechanical contact needing no solder, and the sleeve over the outer conductors drawn down by corrugating tools also into intimate contact, again with no solder. There were 93,000 joints in the Deptford mains, and after a few defective ones had been replaced the conductors have been in service over 35 years. In 1888 Ferranti patented a cable for high-frequency alternating currents, consisting of a number of lightly insulated strands each twisted on itself, and the strands then laid up round a circular core, the purpose being to avoid the " skin effect " as it is termed where high-frequency currents are concerned. Though at that time some currents of frequency up to 300 periods were used, the cable has only of recent years been a necessity and has been rediscovered for radio purposes under the name of the " Litz " conductor. It is really the " Ferranti " conductor. In 1892 Ferranti patented the use of segmentental stranded conductors in multicore cables either rigid or flexible, and later he devised special methods of producing the segmental conductors of such cables by dies. Ferranti was for some years a director of the British Insulated Wire Company, which acquired or was the licensee of his cable inventions.

In 1892, the Deptford undertaking being established, Ferranti left it to devote himself to the expanding busi-

ness. The slow speed engine and flywheel alternator which Ferranti had developed was adopted by many central stations, his own contribution to this type of engine being special arrangements of grid slide valves with cam driving to give better steam distribution than with eccentrics. Great difficulties arose in applying this. In 1891 another important piece of apparatus was devised to meet the requirement of direct current for arc lamps then largely used for street lighting, that was the Ferranti rectifier. In its final form it consisted of a transformer with a movable secondary coil, balanced so that its movements secured a constant current instead of a constant voltage. The current was rectified by a commutator driven by a synchronous motor. In this connection Ferranti patented a current smoothing arrangement of inductance coil in series with the line current, and a condenser or secondary battery in parallel with the mains, a type of device now so much used for smoothing a rectified current for radio reception. In connection with the central station work he introduced the system of oil switches in separate cubicles. In 1896 the Charterhouse Square works became too small, and the Hollinwood works, which had been erected for the manufacture of the Sterne gas engine, were acquired; in 1897 the removal was made, and it was here that the great extension of central station work of all kinds was developed. In 1905 the financial situation became critical and a financial and administrative reorganisation took place; Ferranti then engaged in developing turbines, became consulting engineer to Vickers, Ltd., and it was not until the war period that he again took a very active part in the work at Hollinwood.

In 1910 he became president of the Institution of Electrical Engineers and gave the memorable address referred to elsewhere. He never lost his interest in the topic he developed of the universal use of electricity; he fitted his own home, Baslow Hall, with electrical services for lighting, warming, water heating, cooking, and motive power in the house and farmery. It was probably one of the disappointments of his life that his enthusiasm and missionary zeal in this direction was not shared by supply engineers and authorities generally, and this will account for his diverting his attention from other work to give much personal assistance to the work of the Electrical Association for Women. He has during the last two or three years travelled all over the country speaking at meetings, founding branches, and giving support in many other ways, realising that education through women and the home and the rising generation was necessary to fulfil his ideal. He recently became president of the Electrical Development Association and spent much time on its work with a similar object.

Having traced out the outlines of his electrical work we may now turn to the second great work of Ferranti's career, which concerns the turbine as a prime mover. In 1895 he took out a patent for improvements in steam, hot-air, and other engines. The proposal was for the production of a highly heated gas (steam or air) under pressure, its expansion through a nozzle giving it a high velocity and cooling it, and the abstraction of the energy of motion by a reaction turbine wheel. In his own words " to obtain the highest working temperature of the motor fluid which materials without movement can stand then to carry out the complete expansion of the working fluid through expansion tubes down to the temperature of the exhaust, so that the working parts of the impact engine are not subject to any undue temperature, although the range of temperature in the cycle is extremely great." In 1902 he took out a patent for working steam turbines as far as possible with an isothermal expansion, instead of adiabatic expansion which theory required, his reason being that " the nearer the expansion of the fluid approaches a true isothermal expansion, the greater is the quantity of heat which it is possible to add and convert into work per unit weight of the working fluid." He also points out that in steam turbines by this means the steam may be worked above saturation point thoughout the whole expansion. This process was carried out by passing the steam through superheaters between the expansion stages.

In 1904 he returns to gas turbines, and in a patent for a turbine with a closed cycle of operations deals with the compression stage of the Carnot cycle; just as he had laid stress on the advantage of isothermal as against adiabatic expansion, so he now stresses the advantage of isothermal as against adiabatic compression " as heat put into air by means of mechanical work during compression is much more expensive than heat put in directly from the combustible, and is altogether bad in comparison to heat put in from a regenerator." Here we see Ferranti's practical insight; he knows that if the machinery has 100 per cent. efficiency and size does not matter, the adiabatic cycle of Carnot is the best, but having the fact that the machinery has not 100 per cent. efficiency and that, with isothermal volume changes, the machinery is smaller, he applies the latter. In 1906 Ferranti took out a patent for progressive heating of feed water by what is known as the " bleeding " of the turbine. Here, again, his insight showed him a practical gain from what seemed in theory an incorrect process. The feed water was passed through a succession of heaters; first, the hotwell water is heated by the finally exhausted steam, then stage by stage by a proportion of steam drawn from the ends of the several expansion stages. In effect he conceived that a proportion of the expanded steam at each expansion stage could be more effectively utilised to heat the incoming boiler water than it could be utilised by enlarging the subsequent expansion stages to accommodate this extra steam to produce more power. Both these inventions of his, that is, superheating between stages and bleeding at the end of stages of expansion, have become best practices in turbine economy. In 1905 the whole of this experimental work was transferred to Vickers Works, Sheffield, and in 1910-11 a steam turbine embodying these ideas was built and tested and gave results which at that time were in advance of anything achieved. Ferranti referred to them in his presidential address in 1910. In the course of all this work on turbines Ferranti had developed semi-automatic methods of building the turbine wheels by electrically welding the blades into place; he had also developed compound metal blades, a core of steel with nickel or nickel-alloy surfaces which would stand high temperatures without loss of strength or corrosion, methods of production of blading, experiments on best forms of blades and nozzles, &c., and this work was still in progress when the war came. With the war the Hollinwood works was turned over to shell making, and Ferranti applied his great mechanical ingenuity and skill to this, and there was obtained there the highest output per worker of any shell factory in the kingdom. After the war the experiments with the gas turbine with regenerators was renewed, and a gas turbine run for considerable periods at a red heat without change of form or distortion or, as far as could be determined, loss of strength. All problems seemed to have met with a workable solution except one, the inherently large amount of negative work that any closed cycle approximating to the Carnot cycle involved, with its unfavourable reaction on the net efficiency. He believed he would ultimately overcome this, and it may well be believed, seeing how far he had gone, that he would have done. But whilst others have worked and published from time to time glowing accounts of progress, it is doubtful whether any other inventor has carried the gas turbine to the point of perfection at which Ferranti has left it. And in getting there he has left his indelible impress on the intermediate instrument, the steam turbine.

Now we turn to a further phase of Ferranti's work. Electrical engineers in general do not realise what an enormous amount of work Ferranti put into the problem of spinning cotton threads. From 1906 up to the time of his death, excepting for the war period, he has been continuously working on the problem. Up to 1764 all spinning had been done by hand-spinning wheels. and indeed for spinning flax a form of spinning wheel was used in Scotland as late as 1830. The processes of hand and spinning-wheel spinning were simple. The threads being combed parallel, were taken up a small quantity at a time and laid in line with the fibres mixing, they being drawn out without twisting into a continuous strand of parallel threads, and these were wound on a stick or

distaff. From there a certain length at a time was drawn off the end, attached to the head of a bobbin, which was revolved by the spinning wheel, thus twisting the parallel stranded fibres into a thread. When sufficiently twisted the spun length was wound on to the bobbin and the process repeated. The spinning jenny of Hargreaves, and the mule of Crompton mechanised this process about 1764 so far as related to discontinuous spinning. But there was another process of spinning whereby the process, instead of being a discontinuous one, was continuous by the use of a "flyer" which twisted and wound up the thread. It was Arkwright's invention which mechanised this process about 1769. The various improvements in detail allowed this type of spinning to be carried up to 3,000-5,000 revolutions per minute; above this the vibration and the bending of the flyer under centrifugal force made higher speeds uneconomic. The next step was the ring spinning frame in which, instead of the curved arm with a hole at the end revolving, only the hole revolved, in the shape of a very light steel ring sliding on a fixed track surrounding the bobbin. This allowed a very great increase of speed, say, up to 10,000 rev. per minute, but here other troubles developed, particularly in the matter of the driving bands, which slip and work irregularly, thus breaking the threads and producing inferior work, whilst further the pull necessary to unwind the thread from the feeding bobbin, being conveyed by the spinning bobbin, every inequality in the motion of the latter tends to break the thread. Ferranti cut right across these two difficulties in his first patent of 1903. He proposed to drive each spindle separately by a small polyphase motor or a turbine at the base, and he inverted the twisting operation. Instead of the spinning bobbin drawing off the threads from the fixed supply bobbin and winding it upon itself, Ferranti spun the supply bobbin, drawing off the thread by feed rolls geared to the supply bobbin, so maintaining a constant feed to spinning ratio, and wound the finished thread on to a fixed bobbin. This procedure is especially applicable to the doubling or twisting of several spun threads one upon another. In another patent he returns to the principle of the ring spinning arrangement, but having given the spinning bobbin a perfectly regular motion by the air turbine, he substitutes for the retarding ring dragged round on its encircling channel, an independently driven encircling tube carrying the thread through a hole and having a perfectly definite retardation. In order to allow of the high speeds of rotation necessary there are arrangements for bearings supported on compressed air, so avoiding lubrication by oil, and arrangements for taking the weight of the revolving parts by air or magnetic lift. Further patents cover self-aligning and self-centring bearings to allow the spindle and bobbins to revolve about their dynamic centre of mass, and many other matters of detail. Nothing has been published as to this work, nor has it reached finality, and whether the greater refinement of the machinery and accessories will justify itself economically time will show. In any case it exhibits the mechanical side of Ferranti's work probably at its best. Space prevents more than the merest reference to other activities and inventions, spectacle frames on a new system, wire bands for driving cycles instead of chains, electrical production of white lead, electrical furnaces, the Ferranti stop valve, motor car wheels, motor tires, and latterly special machinery for winding coils for radio work, with which as much as 2,500 miles a day of the finest enamelled wire is wound automatically. So one might go on.

Through all this work we see certain predominant facts. Ferranti was not a mathematical thinker, his inventions appear to be the result of extraordinarily clear appreciation of the elements lying in a problem, a power of visualising a complete apparatus and a wonderful mechanical aptitude. His machines, and the tools with which he made them, are beautiful.

Ferranti was not a great electrician in the sense that Kelvin, Fleming, Marconi, and others have been; for instance, he never seems to have tried to solve the problem of the alternating current motor, where very complex electrical and magnetic problems are involved. His talent was the vision and mechanical skill with which he carried out electrical problems. It appears as if he himself realised this, as in his patents he describes himself as engineer and electrician, "engineer" first.

Ferranti was, as might be supposed, strongly individualistic. He worked practically alone all his life; he appeared not to have much confidence either in industrial organisations or in research of a co-operative nature, he believed that in both these directions the individual mind counted for more than all that might be gained by grouped intelligence.

Whence came those talents? It is always fascinating to speculate on the source of genius. His grandfathers, to go no further, were of mixed lineage, English, American, Italian, French. His mother, whom he adored, was, the writer believes, of Slavonic race. It is from such ancestries that what the biologists call "sports" arise, a new characterisation seeming to differ from all that went before, not much perhaps traceable to that Italian ancestor, Sebastiano Ziani, who was Doge of Venice in 1172, the 41st from the foundation of the order in 697.

But beyond these questions, what of the man? What was it that contributed to his extraordinary power of attracting such loyal and devoted service from those who worked with him, what was it that enabled him to convince hard-headed financiers, customers, friends, and even opponents, that his ideas were right? Something which for want of a better word we call personal magnetism, but perhaps if we analyse it lies here, a perfect gentleman, concerned with his art rather than for what it brought, always calm and serene, such almost boyish simplicity and delight in his work, and unostentatiously a devout man. Happy in his marriage and surrounded by a delightfully united family, he was able to meet the reverses of fortune with courage and its favours with simplicity. Gone from us all too early, some of his work not yet finished, yet of him we may say with Hegel: "He who likes his work and loves his wife has squared his account with life." But for us who remain we may again quote, now from George Eliot: "It is always good to know, if only in passing, charming human beings. It refreshes one like flowers and woods and clear brooks."

The Funeral.

The interment took place on January 17th at the Hampstead Cemetery, London, N.W.2, in the family vault. Father Reardon conducted the service. The mourners included Mrs. S. Z. de Ferranti (the widow); Mr. and Mrs. Vincent Z. de Ferranti; Mr. and Mrs. W. Craddock Pycroft; Dr. and Mrs. J. W. E. Ord; Mr. Denis Z. de Ferranti; Miss Yvonne Z. de Ferranti; Miss J. Z. de Ferranti; Mr. P. de F. C. Pycroft; Mr. R. de Castelnau; Mr. M. Z. de Ferranti; Mr. J. O. Ince.

Sir Andrew Duncan and Sir Archibald Page (Central Electricity Board); Mr. T. P. Wilmshurst (Electricity Commissioners); Col. Sir T. F. Purves and Mr. P. F. Rowell (Institution of Electrical Engineers); Dr. F. E. Smith (Royal Society); Mr. Ll. B. Atkinson (Royal Society of Arts); Mrs. Hammer and Miss C. Haslett (Electrical Association for Women); Mr. D. N. Dunlop (British Electrical and Allied Manufacturers' Association); Lt.-Col. W. A. Vignoles and Mr. V. Dale (Electrical Development Association); Ad. Sir Edward Charlton; Col. R. E. Crompton; Mr. and Mrs. Roger T. Smith; Mr. W. M. Mordey; Mr. H. Marryatt; Major J. Caldwell; Mr. G. W. Partridge; Mr. A. Nichols Moore; Mr. A. C. Cramb; Capt. J. M. Donaldson; Dr. A. Russell; Dr. W. H. Eccles; Mr. G. L. Addenbrooke; Mr. Hirst; Mr. H. W. Kolle; Mr. Seetham; Mr. R. H. Fox; Mr. T. E. Bakker (The Hague); Mr. J. Christie; Mr. F. Bailey; Major P. D. Thomas; Major W. R. Cooper; Mr. A. M. Sillar; Mr. and Mrs. A. E. Hadley; Col. Behrand; Mrs. R. P. Wilson; Mr. and Mrs. C. H. Merz; Mr. J. R. Beard; Mr. C. P. Sparks; Capt. A. C. Sparks; Mr. L. S. Morshead; Mr. and Mrs. H. C. Lamb; Mr R. A. Hopkinson; Prof. W. C. Clinton; Mr. V. Watlington; Mr. C. Rodgers; Mr. F. S. Button, J.P.; Mr. W. E. Warrilow.

Messrs. Schofield, A. Hall, Davis, Bass, Tyldesley, and representatives of the workpeople.

The technical Press was represented by Mr. L. St. L. Pendred (*Engineer*), Mr. R. W. Hughman (*Electrical Times*), and Mr. W. O. Fenwick (ELECTRICAL REVIEW) and others.

A memorial service was held at Manchester at the same hour, and was attended by some 1,500 people from the Ferranti works.

Thermal Applications of Electricity.

The derivation of expressions whereby the price per kilowatt-hour to compete with coal and gas can be calculated, and a discussion on commercial policy and on progress in Europe and America.

By M. F. HARTMANN and M. L. CHAUVAC, Engineers to the Electricity Department of Strasbourg.
[Translated by L. G. A. Sims, M.Sc. (Eng.)]

(*Concluded from page* 101.)

Numerical examples.—We will compare the electrical storage water heater with an instantaneous-type gas heater (which is its principal competitor), and later with a storage-type gas heater.

From various tests made by different people, and applying the results to different apparatus, it is known that the thermal efficiency of the instantaneous type of gas heater varies, according to the case concerned, from 50 per cent. to 80 per cent.

It is to be noticed that the efficiency increases as the output increases and with lower outgoing water temperature. On the other hand, several other effects, such as deterioration of tubes by the acids produced from the products of combustion, bad regulation of the air to the burners, &c., will lower the efficiency. We shall take 65 per cent. as an average figure.

The efficiency of the gas-fired storage apparatus is generally lower, due to the losses *via* the ventilating chimney, from the surfaces which cannot be heat-insulated; also the presence of deposits on the heating surfaces considerably lowers the efficiency by reducing the heat transmission coefficient.

In the examples which follow we have not considered the costs of connecting the different apparatus, as these are approximately equal.

Comparison of a storage-type electric water heater with a gas-fired direct-flow geyser.

(*a*) *Electrical case.*—We assume the following characteristics :—Capacity 27½ gallons.

H_e = 2,500 hours	P_1 = 12%
L_e = 1.5 kW	P_2 = 5%
A_e = £15 7s. or 3,690 pence	P_3 = 0%
B_e = £9 14s. or 2,328 pence	P_4 = 0%
T_{he} = 19s. 4d. or 232 pence	P_5 = 0%
T_e = 12s. 10d. or 154 pence	P_e = 17% or 0.17
R_e = 90% or 0.9.	

(*b*) *Case of gas apparatus.*—We assume a water flow of 2.86 gallons per minute, and the following characteristics :—

A_g = £8 or 1,920 pence	P_1 = 12%
C_g = 7.064 cubic ft./kWh	P_2 = 5%
F_g = 4s. 3d. per 1,000 cubic ft. or 0.051 pence per cubic ft.	P_3 = 0%
T_{hg} = 3s. 10½d. or 46½ pence	P_4 = 0%
W_g = 486 B.th.u./cubic ft.	P_5 = 0%
	P_g = 17% or 0.17
R_g = 65% or 0.65.	

By applying formulæ (5), (6), and (7) we obtain :—

$K''_{e\ max}$ = 0.39 pence.
$K'_{e\ max}$ = 0.43 pence.
$K_{e\ max}$ = 0.5 pence.

Parity would therefore exist between gas and electricity with prices per kWh as follows :—

(*a*) 0.39 pence if all charges are considered.
(*b*) 0.43 pence if meter and time switch hire is neglected.
(*c*) 0.5 pence, considering energy and fuel costs only.

Comparison of a storage-type electric water heater with a gas-fired storage-type heater.

(*a*) *Electrical case.*—We shall take an apparatus having the same characteristics as that above.

(*b*) *Case of gas apparatus.*—The apparatus will have the following characteristics :—

Capacity 27½ gallons.

H_g = 2,500 hours	P_1 = 12%
A_g = £9 14s. or 2,328 pence	P_2 = 5%
B_g = £6 9s. or 1,550 pence	P_3 = 0%
F_g = 4s. 3d. per 1,000 cubic ft. or 0.051 pence/cubic ft.	P_4 = 0%
T_g = 2s. 7d. or 31 pence	P_5 = 0%
C_g = 7.064 B.th.u./kWh	P_g = 17% or 0.17
R_g = 50% or 0.5.	

Applying formulæ (1), (2), and (3) above we obtain :—

$K''_{e\ max}$ = 0.56 pence.
$K'_{e\ max}$ = 0.6 pence.
$K_{e\ max}$ = 0.65 pence.

In order to show the general applicability of the formulæ, namely, that they apply to other cases than that of water heating, we propose to give two further numerical examples, one applying to the electric kitchen and one to a metallurgical furnace.

Domestic kitchen.—It is well known that the economic advantages of electricity are important in the case of industrial kitchens (large hotels, hospitals, &c.) due to the high efficiency of the large capacity apparatus which is used and to the specialised processes which are concerned. Unless a judicious choice of apparatus is made these advantages are less apparent in the domestic kitchen. But there is on the market apparatus which is extremely adaptable to the needs of the middle-class household and which has a very satisfactory efficiency. It comprises a heating element which may be situated at the bottom (the " électro-économe " model) or in the cover of a heat-insulated vessel in which are placed, in different utensils, the foods to be cooked. A regulator cuts off the current as soon as the temperature reaches a certain value. Cooking proceeds partly by direct and partly by accumulated heat. The interest which this apparatus has aroused is shown by the fact that the Electricity Department of Strasbourg succeeded in selling, during one year, nearly 700 of them, thus increasing its output by nearly 500 kW. The apparatus has

given satisfaction to consumers, who find that they can get on with other work, while the apparatus is working automatically, without fear of the food burning or of an excessive current consumption.

Let us compare one of these "électro-économe" cookers, rated at 700 watts and suitable for three to five persons, with a gas cooking stove having three boiling rings and roasting oven, and later with a suitable coal-fired cooker.

In this application we have not taken account of meter hiring charges. They are approximately equal for gas and electricity, and in the case of coal they can be considered as compensated by the additional cost of storage. Should these conditions not be realised it will be easy to employ formula (5) for any special case.

(*a*) *Electrical case.*—The following characteristics apply to the "électro-économe" cooker :—

H_e = 600 hours
L_{kw} = 0.7 kW
A_e = £4 12s. 9d. or 1,113 pence
R_e = 80% or 0.8

P_1 = 12%
P_2 = 5%
P_3 = 0%
P_4 = 5%
P_5 = 0%

P_e = 22% or 0.22

(*b*) *Case of the gas cooker.*—We shall assume a cooker having the following characteristics :—

A_g = £6 9s. 5d. or 1,553 pence
F_g = 4s. 3d. per 1,000 cubic ft. or 0.051 pence per cubic ft.
W_g = 486 B.th.u./cubic ft.
C_g = 7.064 cubic ft./kWh
R_g = 45% or 0.45

P_1 = 12%
P_2 = 5%
P_3 = 0%
P_4 = 3%
P_5 = 0%

P_g = 20% or 0.2

Applying formulæ (6) and (7) we obtain

$K'_{e\ max}$ = 0.77 pence.
$K_{e\ max}$ = 0.64 pence.

Thus parity would exist between electricity and gas at the above prices per kWh, for the case when all charges except meter hire are considered, and also for the case when only energy costs are taken into account.

(*c*) *Case of coal-fired cooker.*

A_c = £6 9s. 3d. or 1,553 pence
F_c = £2 2s. 10d. per ton or 0.229 pence per lb.
W_c = 11,720 B.th.u. per lb.
C_c = 0.29 lb. per kWh
R_c = 12% or 0.12

P_1 = 12%
P_2 = 5%
P_3 = 20%
P_4 = 2%
P_5 = 0%

P_c = 39% or 0.39

By formulæ (6) and (7) we obtain

$K'_{e\ max}$ = 1.13 pence.
$K_{e\ max}$ = 0.44 pence.

Metallurgical furnace.—Electricity has a vast field of usefulness in metallurgy. The advantages of the electric furnace from the point of view of thermal efficiency, ease of regulation and of operation, economy of labour, &c., are beyond dispute.

Let us take the example of a crucible capable of melting 44 lb. of aluminium and contrast it with a comparable coke-heated crucible.

Again neglecting meter hire and taking for electrical melting the following figures, we have

(*a*) *Electric case.*

H_e = 1,500 hours
L_{kw} = 6 kW
A_e = £96 19s. 6d. or 23,270 pence
B_e = £16 3s. or 3,880 pence
R_e = 60 % or 0.6

P_1 = 12%
P_2 = 20%
P_3 = 20%
P_4, P_5 = 25%

P_e = 77% or 0.77

(*b*) *Case of coke heating.*

H_c = 1,800 hours (1,500 hours actual use)
A_c = £22 13s. or 5,440 pence
B_c = £2 14s. or 648 pence
W_c = 12,600 B.th.u. per lb.
F_c = £1 12s. 7d. per ton or 0.175 pence per lb.
C_c = 0.271 lb./kWh
R_c = 10% or 0.1

P_1 = 12%
P_2 = 100%
P_3 = 200%
P_4, P_5 = 300%

P_c = 612% or 6.12

By formulæ (2) and (3) we find

$K'_{e\ max}$ = 0.73 pence.
$K_{e\ max}$ = 0.34 pence.

Discussion of results obtained in the case of water heating.—The numerical results obtained for the maximum prices per kilowatt-hour in the case of water heating, although based on mean values, show that electricity supply companies can, by night tariffs, assure themselves of a strong position relative to their competitors.

The figures employed for the period of use and the efficiency of the electrical apparatus may appear a little high, but they constitute normal figures if, from the commencement, the supply company observes certain essential principles, of which we shall speak later. Wherever conditions are not at present thus, joint effort on the part of the consumers and the supply company will allow these figures to be easily realised.

We will now examine the ways in which the different factors entering into the various formulæ can vary, and how a solution can be found to the conflicting interests of the supply authority, on the one hand, wishing to sell energy at the highest economic price and of the consumer, on the other hand, wishing to reduce his costs. The essential relevant factors are the period of use, the efficiency of operation, the price of apparatus, and the charges for meter hire. We shall examine these in order.

(*a*) *Period of use.*—It is essential to inform the public and the installation contractors of the importance of the manner in which the water heaters are used, for this has a direct effect upon the efficiency.

The time at which the water is used should be considered, whilst the manner of use is of great importance. Use and efficiency are intimately bound together, and we shall therefore consider efficiency as the focus-point of the whole question and deal with it now.

(*b*) *Efficiency.*—The capacity of the water heater should correspond with the predicted daily consumption. In the same way that it is not economical to run a large electric motor to drive a small load, it is incorrect to use a water heater which is only occasionally emptied. The supply company will find itself faced in practice by three classes of consumer :—

(1) The person having a daily consumption approximately equal to the total capacity of the apparatus.

(2) The person whose consumption curve shows sharp peaks.

(3) The person who only uses his apparatus occasionally.

The first class works the apparatus at high efficiency and consists in general of large families or of families of the upper class.

The second class will, if the supply authority does not take precautions, become the most important. It is this type of consumer who, by reason of his indifferent demand characteristic, will work his apparatus at an inferior efficiency because of over-large radiation losses, and who may raise objections to the costs of operation. The supply company should endeavour to bring this class of consumers to see the advantage to themselves of a greater and more uniform demand by showing them that it is more convenient and cheaper to use the heater for the provision of all hot water, not merely for bath and toilet purposes.

If it is impossible to improve the low-consumption periods, then the consumer should be advised to use an auxiliary water heater of small capacity, or to use a combination type of heater. This advice amounts, in effect, to suggestions for reducing radiation losses.

An auxiliary small-capacity heater presents many advantages which result from its size and low-consumption element, and it is often run on the constant-heating principle on a day tariff. As an example of its successful application it may be stated that the Amsterdam Electricity Department has installed a number of these heaters having capacities of one and a third gallons (diameter about 8¼ inches, height about 15¾ inches), rated at 500 watts, with thermostats to limit the water temperature to 85 deg. C. These heaters have proved to be much appreciated by small consumers.

The combination type of water heater allows, by means of a special arrangement of the heating elements, in conjunction with a hand operated two-way switch, the whole contents or only the upper portion (usually one-third of the contents) to be heated at will. The loadings of the main and auxiliary elements are different, so as to give the full temperature rise during eight hours in both cases. This arrangement results in reduced radiation losses. Tests have shown that the losses from the apparatus when only the upper portion is heated are less than those from an ordinary water heater of capacity equal to that portion. In addition, it has been found that, with a certain heater of 33 gallons total capacity, a saving of about 14 kWh per week results over the ordinary operation when the upper contents only are heated on six days of the week and the total contents on one day.

In the case of consumers who do not use their apparatus at all on certain days it is essential that the heater be cut out entirely during those periods. A hand-operated switch should be included in the equipment, and suitable instruction given on its use. In this connection it may be stated that, in calculation, a mean cooling rate of 0.8 deg. C. per hour may be allowed for a heater of 27.5 gal. capacity, and 0.3 deg. C. for 88 gal.

Another factor having an important effect upon the efficiency is the arrangement of the installation. Many water heaters are installed in bathrooms with pipework feeding the kitchen or other points. The water in the pipework quickly becomes cold, and the thermal energy lost in drawing off this water has been known to amount to as much as ten times that used. The effect is, of course, greatest when the distant outlet points are used frequently. To remedy this state of affairs it is essential that contractors and architects should allow for the correct positioning of the heater, so that proper provision be made at the time of building.

(*c*) *Price of apparatus.*—The formulæ show clearly the effect of the cost of apparatus upon the price per kWh.

The storage water heater has the disadvantage of a higher price than gas apparatus of either the accumulation or instantaneous type, particularly the latter. This disadvantage can be reduced considerably if judicious use is made of the credit system of selling. The electric heater lends itself to this system by reason of its long life, its indispensability in the household when once installed, and, in some cases, its novelty. There is therefore no need to fear that a consumer will abandon his apparatus after the first few payments. As an example, it may be stated that 20 per cent. of the apparatus in Strasbourg has been sold on the deferred-payment system.

To reduce the part played by the cost of apparatus in determining the price per kWh, landlords and architects should be educated to provide water heaters when constructing new houses, and to defray the cost by a slightly increased rental. Such a system also permits of the best possible heat insulation of the pipework.

(*d*) *Meter and time-switch hire.*—In order to improve the supply load factor water heaters are generally used in conjunction with time-switches. If the latter are to be dependable their cost is rather high, and hiring rates must also cover the expense of checking and repairing the clocks, for these need to be visited occasionally.

To prevent these costs reacting too heavily on the price per unit, several procedures may be adopted.

(1) Central control from the station by means of impulses of special frequency acting on consumers' relays is possible; conclusive results are not yet known.

(2) Another solution consists in controlling the largest possible number of heaters by one time-switch. This procedure is favoured in Switzerland and in Zurich; for example, whole groups of houses possess only one time-switch between them. The disadvantage lies in the possibility and results of a switch breakdown.

(3) A recent method, which is coming into vogue in Germany, is the use of the synchronous-motor time-switch, in which the clockwork is replaced by a small synchronous motor. The price of this type of switch is low compared with that of the ordinary clock-driven type, and the power consumption is of the order of a few watts only.

Periodicity must be very steady, and interruptions of supply should be very rare and of short duration.

Experiences of American supply companies.—Certain American companies have renounced the time-switch definitely, and have sought by other means to distribute the water-heating load over the off-peak hours. We will note the means that have been adopted to solve the problem, although the conditions may differ.

In contrast to our case (*i.e.*, Strasbourg), the development of the electric kitchen in the United States has preceded that of domestic water heating. It was primarily to complete the elimination of coal and gas firing that the water heater was adopted there. At first heaters with elements of very low loading were used, in circuit continually on a contact tariff and generally without thermostatic control. But it was soon recognised that, on account of the low contract tariff, two-way switching was necessary to prevent the simultaneous operation of the cooker and the water heater, and thus to limit the peak load. For the same purpose automatic load levellers were employed.

To obviate to some extent the disadvantages of the contract tariff, such as small revenue per kWh, tendency to energy wastage, low efficiency, &c., certain companies adopted the two-element water heater. This comprises first a low-loading element, constantly in circuit on a contract tariff and adequate for the normal hot-water demand, and, secondly, another element of a higher loading of 3 or 3½ kW, hand operated. This element takes current from a metered circuit on a higher tariff. It provides quickly the occasional large hot-water demands, and has a single thermostat situated in the upper part of the tank. This arrangement has given satisfaction to both consumer and supply authority by assuring a good load-factor and, in the case of the hand-operated element, a good diversity factor.

A system which has been much used consists in the employment of a heater of high loading, 2.5 to 6 kW, with a relatively small reserve water capacity, operating on a metered supply and thermostatically or hand controlled. In certain cases two-way switches have been used to limit the peak load.

Disadvantages of these systems, such as the high cost of 3-wire services, daily peaks, great danger of producing steam when no thermostat is employed, &c., are leading American companies to adopt the large capacity, well-insulated water heater with thermostat and low-rated element, in order that, even without a time switch, about half of the energy consumption shall occur during the night, or at least during off-peak hours.

Conclusions.—We have endeavoured to show how difficulties encountered in the sale of water heaters can be met, and stumbling blocks avoided, and to indicate the advantages to all concerned which may result from a reduction of tariffs.

It is essential to endeavour to educate contractors, architects and the public; merely a favourable attitude to water heating, without a deeper consideration of its complete functions, is wrong.

Translator's Note.—This article appears with the permission of the Editor of "Revue Générale de l'Electricité." The authors are supply engineers who have had experience of building up a large water-heating load, Strasbourg being one of the most advanced towns of Europe in this respect. Their opinions should therefore be of considerable interest. In translating the article I have shortened it a little, but nothing of importance is omitted. The numerical values given have all been converted literally into English equivalents. They still apply, therefore, to French average conditions, which should give added interest to the translation. The form in which the calculations are made will permit readily of the substitution of other figures in cases where British and French conditions do not correspond.

Load Curves in Silhouette.

A graphical method of recording the daily load in use on the system of the British Columbia Electric Railway Co.

By F. H. FULLERTON.

THE method here described, which has been utilised with complete success for the past couple of years, gives a complete record of all variations in the load, and presents it in such a manner that the output at any time of any day of the year can be seen at a glance. The system consists of 365 cardboard charts, which are cut in the shape of the daily kilowatt-hour load curves of the company's system. The first card has cross ruling, while the succeeding cards are made from plain cardboard. The cards are arranged in proper order of date, and the whole collection is assembled on a wooden tray.

Each daily chart begins at midnight and finishes at midnight. The hours are represented by the vertical lines ruled on the first chart and on a card which is inserted at the back of the collection of charts and rises above them. The horizontal lines represent the hourly output reading. It is thus easy to see at a glance, for instance, that the highest peak of the year is 86,600 kW, as recorded at 6 p.m. on December 21st.

Certain features of the daily load curves have been found to be common to practically all of the charts; for example, there is a deep and wide valley running throughout the charts for the entire year during the small hours of the morning, then there is a rapid rise about 7 a.m., and the small narrow gully of the noon period, and the high evening peak.

Fig. 1.—A Graphic Load Curve.

In spite of these strong similarities it has been found, however, that no two daily load charts are exactly alike. A variety of factors enters into the shape of the load, but there are two important and broadly defined influences which may be segregated into separate classes, namely, those which result from seasonal conditions, and those which result from incidental happenings. Of these the former are the most important, and the manner in which these seasonable influences shape the load variation into a formidable peak towards the close of the year is clearly shown in the charts. During the summer the industrial load of the day and the early evening rush-hour street railway traffic and inter-urban lines power load have concluded long before the evening lighting load commences. A distinct valley is therefore seen in the charts after 6 p.m., during the summer months of the year, and as the season advances in time until it merges first with the rush-hour street railway load, and later also with the industrial load, culminating eventually in the peak of the year, which generally occurs on some dull and heavy day during the Christmas season.

The incidental influences which enter into the shape of the daily load curves are many and varied. There is, of course, the important weekly decline which makes the Wednesday, Saturday, and Sunday curves of a different shape from those on Monday, Tuesday, Thursday, and Friday, owing to the half holiday and holiday of the majority of the plants on some of these days.

It is a curious circumstance that the chart for a typical winter's day bears a close resemblance to a man's face, while the variations in the load for various succeeding days provide changes of expression on his feature.

Quite a human interest record of the events of the year is also shown in these charts. There is the high peak in the late hours of New Year's eve, which tells its own story of late tramway cars and midnight revels at which electric light was consumed. There are the high peaks caused by the summer's annual exhibition period, which stands up all the more by reason of the decline in the domestic lighting load in summer, due to the vacation season. These are but a few of the many periods of the year and events which leave their definite mark on this type of load chart in three dimensions. Those interested are referred to the ELECTRICAL REVIEW of June 22nd, 1928, p. 1098, for an account of a similar method used by the New York Edison Co.

Electrically-propelled Ships.

It is reported that the contracts for the two projected turbo-electrically propelled liners for the Peninsular and Oriental Steam Navigation Company have been given to Messrs. Vickers-Armstrongs, and that the ships will probably be built at Barrow. They are to be larger and faster than the *Viceroy of India*, built on the Clyde last year. The electrical equipment will be supplied by the British Thomson-Houston Company, Limited.

Electricity for the Home.

Progress made by the Rotherham Municipal Electricity Supply Undertaking in Domestic Electrification; New Manufacturers' Items.

THE progress made by the county borough of Rotherham electricity undertaking in domestic electrification since 1926, when it seriously commenced activities in that connection, is very creditable for two particular reasons: first, the area has a working-class population which would not be likely to adopt electric cooking or heating without careful consideration of the economic viewpoint; secondly, the undertaking has a very difficult proposition in its competition with the gas undertaking, which buys coke-oven gas and is able to sell it at 3s. per 1,000 cu. ft. Both the gas and electricity undertakings are corporation departments, and therefore intensive competition between the two concerns is discouraged. Where, however, electricity can be installed without displacing a gas fire or a gas cooker, then the electricity department is at liberty to go in and win.

Mr. Edward Cross, M.I.E.E., the engineer and manager of the undertaking, is a great believer in the two-part domestic tariff, and at the moment the charges at Rotherham are 13 per cent. of the ratable value of the consumers' property plus 0.65d. per kWh. It should be mentioned here that during the general strike of 1926 the electricity tariffs in the borough were not increased, and because of that a depleted reserve has had to be replenished during the subsequent years; but for that fact it is believed that the present charges would certainly be down to 10 per cent. of the ratable value plus 0.5d. per kWh. A flat-rate lighting tariff of 4½d. per kWh is also in vogue.

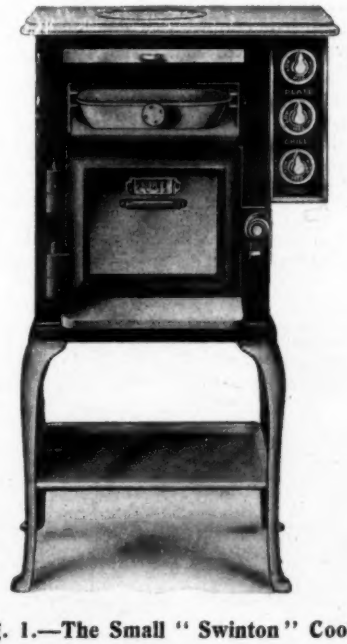


Fig. 1.—The Small "Swinton" Cooker.

The undertaking is experiencing rapid progress in the work of domestic electrification, in spite of the fact that very little is done in the way of advertising. The bulk of the business is done by sheer recommendation. Over 600 cookers are now out on hire, and over 1,000 radiators; a similar number of radiators have been purchased from the undertaking. Most of the radiators out on hire are of 2-kW capacity. As regards electric cookers, Mr. Cross believes that the frying pan should be scrapped and the grill used, and that the closed plate is the more efficient type if advantage is taken of the residual heat. The undertaking is gradually taking out the open-type plates on its existing cookers and introducing at least one solid plate per cooker.

The only complaints which the Department has received from its consumers with regard to electric cookers has been of the slowness of the boiling plate. Bearing on this the engineer believes that it is necessary for a plate to be introduced with a much higher loading, and that the higher loaded plate will be more economical.

Fig. 2.—"Cosmos" Reflector Fire.

The undertaking hires out two models of electric cookers suitable for four and eight persons, respectively, the hiring rates being 3s. and 5s. per quarter. The cookers are manufactured by Messrs. Hattersley Bros., Ltd., Revo Electric Co., Ltd., and Credenda Conduits Co., Ltd. The smaller cooker is by far the most popular at Rotherham, particularly the "Swinton" 0/11 Model, fig. 1, for which the demand is rapidly increasing. It is constructed on modern lines, embodying all the latest improvements, including an 8-in. "Sadia" boiling plate, loaded at 1,600 watts, under which is fitted a vitreous enamelled drip tray, so that liquid which boils over cannot come into contact with the grill, which is of the open spiral type and is loaded 1,800 watts. The oven, which is 12 in. wide by 10 in. high by 11 in. deep, is vitreous enamelled and easily removable; it is heated from the sides and bottom, ensuring, it is claimed, uniform heating. The "Swinton" cooker has a small hob which appears to catch the eye of the hirer. Whatever the make of cooker, the undertaking insists on having a grill quite distinct from the oven itself, and also a distinct boiling plate. The small type of cooker hired out can be supplied with a stand at 1s. per quarter extra.

The department encourages the use of "all-enamelled" appliances for hiring purposes. Such goods, after being wiped down with a damp cloth, can be sent out a second time, and are not regarded by the consumers as secondhand. In this way a smaller amount is necessary to be set aside for depreciation, and lower hiring rates can be offered.

At 2s. 6d. per quarter the Corporation hires out and maintains 2-kW electric fires of the vitreous enamelled cast-iron type in black, blue, grey, brown, or green,

supplied by Messrs. Hattersley and Revo Electric Co., Ltd., and of the reflector type by Metropolitan-Vickers Electrical Co., Ltd., Edison Swan Electric Co., Ltd., and Credenda Conduits Co., Ltd. Free wiring up to 25 ft. is supplied with the enamelled fire, but not with the reflector models. Fig. 3 shows an example of the enamelled cast-iron fires. It is the "Pearl" fire supplied by the Revo Electric Co., Ltd. Its attractive design harmonises with any style of decoration, and when finished in pearl grey the fire is very suitable for bedroom use. The dimensions are 16½ in. by 16½ in. by 5 in.; it weighs 23 lb. One of the reflector fires in question is the "Met-Vick" standard 2-kW fire depicted in fig. 2. This fire is specially designed to give a maximum of radiant heat, coupled with a pleasing glow. The model is made of substantial copper sheet, and the reflector is scientifically shaped to throw the heat given out by the elements forward in a diverging beam. The spreading of the heat rays is further increased by means of the hammered surface of the reflector. A door at the base of the reflector is specially provided to throw a beam of heat along the floor. A wire guard, whilst protecting the elements from contact or damage, also forms a convenient and substantial shelf on which kettles, plates, &c., can be heated. The reflector is constructed of hammerd copper.

Considerable help in its work of domestic electrification has been obtained by the undertaking as a result of the bold step taken in renewing and enlarging the mains on the occasion of the change-over from d.c. to a.c. a few years back.

It is interesting to note that the undertaking is now experimenting on a new system of charging for domestic supply, which is at present only applicable to council houses. The standing electricity charge, the meter rent,

Fig. 3.—"Revo" C.I. Fire.

and the cooking hire rate are all collected weekly with the rent of the premises, and the unit charge is obtained by means of a slot meter calibrated on the basis of 0.65d. per unit.

The total number of domestic consumers at Rotherham is about 10,600, and in the past 20 months considerably over 3,000 consumers have been connected to the mains under the assisted-wiring scheme. The present maintenance costs at Rotherham work out at 11s. 7d. per annum per cooker, and 1s. per annum per fire.

The engineer and manager intends to act on his belief that much might be done in extending domestic electrification by increasing the usefulness of meter inspectors. There is no reason why the right class of man should not advise consumers on electrical matters and also carry out small electrical repairs. The meter inspectors and readers are the only people who get directly in touch with the consumers regularly.

As an experiment the Rotherham Corporation has equipped six of its council houses as "all-electric." These houses are of the "parlour" type, with six rooms and a bathroom. The living room has an ordinary coal-fired kitchen range, with a hot-water boiler at the back, as one coal fire was considered advisable as a ready means of destroying undesirable rubbish. Each house is equipped with electric fires, a "Revo" cottage electric cooker, with a plate rack, a "Steemkleen" wash boiler, and an immersion heater in the cylinder to enable hot water to be obtained when the kitchen fire is not lit, or to supplement the kitchen fire. The average consumption per house over the past three years is 2,300 units per annum, at a cost of about £8 6s. per annum.

A New Fire.

The "Ess" two-bar electric, fig. 4, is a recent introduction by Messrs. S. SCHNEIDER, 3, Hanover Court, Moor Lane, E.C.2. It is said to cost little more than an ordinary bowl fire, giving more than double the heat, and it is attractive in appearance. There are two specially constructed bar elements, emitting the maxi-

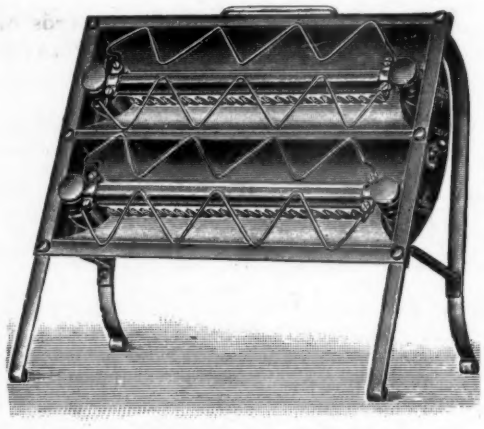


Fig. 4.—The "Ess" Two-Bar Fire.

mum of heat, and the highly polished brass parabolic reflectors behind each element are claimed to ensure an even and widespread distribution of the warmth. Each element is fitted with a wire guard, and is so constructed that it can easily be taken out and replaced. The loading of each element is 500 watts, and a switch at the side of the fire allows either one or both bars to be put in operation. The outer casing and legs of this fire are of brown galvanised-copper, and the whole construction is sound and destined for hard wear.

A New Electric Iron Connector.

The accompanying illustration, fig. 5, shows a new pattern electric iron connector which has been introduced by the REVO ELECTRIC CO., LTD., Britannia Works, Tividale, Tipton. The tubular sockets, which are slotted into four sections, are supported by a spring-steel ring which ensures perfect contact for the whole length of the iron pins, thus reducing to a minimum the heating up of the contacts. By the introduction of the steel-spring ring loss of temper is avoided, and a smooth permanent sliding action is assured. The provision of a further groove around the brass socket fixes the fulcrum at that point, and the movement of the segments in and out to

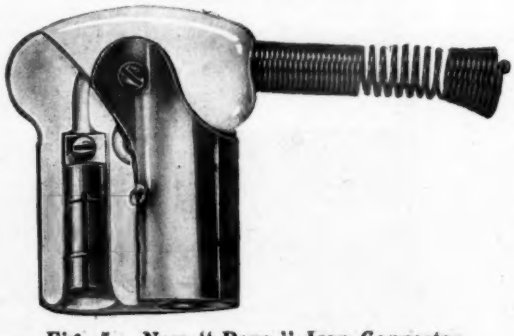


Fig. 5.—New "Revo" Iron Connector.

accommodate the pin hinges on that point. The side entry for the flexible lead is kept away from the hand, and the spiral spring, which is bell mouthed, prevents the flex from chafing, whilst the flexible is firmly held between the two porcelain halves which form the body of the connector, the porcelain at this point being fluted, so that it engages and grips firmly the braiding of the flexible lead. The flexible copper conductor is attached to the socket under the head of a screw, and not by the grub-screw method. This avoids damage to the wire and ensures a very firm anchorage.

An Electrical Telerecorder.

The electrical transmission of records on an essentially "dry" system, the action of which depends upon variable inductive effects in a transmitting coil situated in an alternating magnetic field.

By A. H. Avery, A.M.I.E.E., A.Inst.P.I.

THE measurement of steam flow, water level, weight, pressure, temperature, &c., is in constant requisition in all engineering undertakings, at distances remote from their origin. The steam engineer may require visible indications in his own office of what goes on in the boiler-house; the water engineer may need rapid and accurate information about the water level in a reservoir, distant perhaps a mile or more; in fact, distant indicating and recording are becoming more and more essential to industrial processes and control, and electrical methods of solving such problems are developing many new lines of instruments of greater or lesser precision for the purpose outlined above.

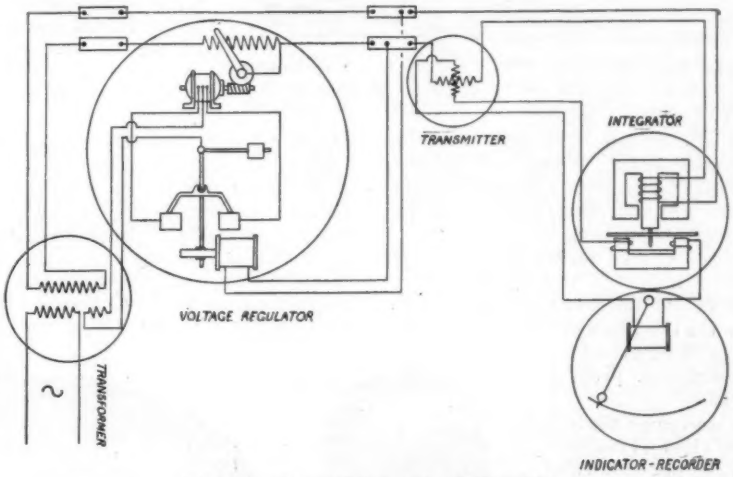
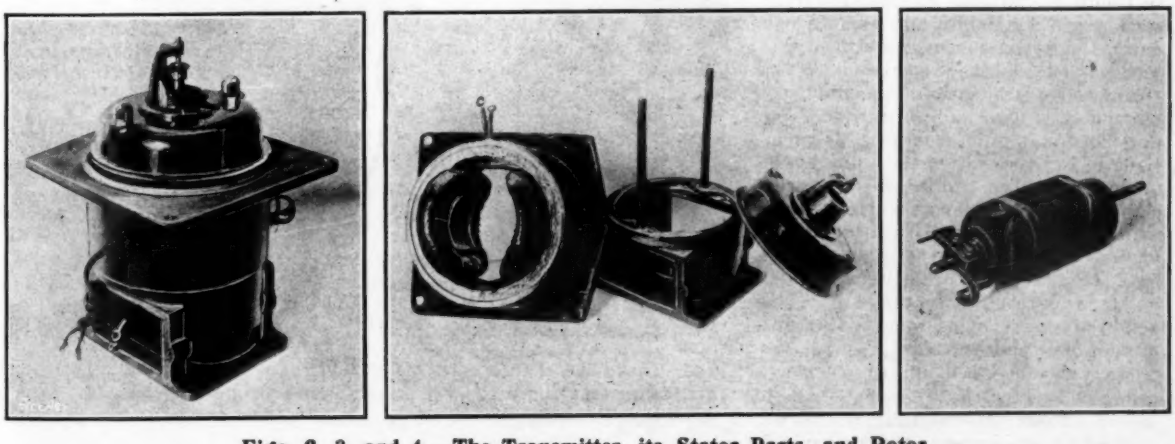


Fig. 1.—General lay-out of Circuits.

The task is fraught with a good many difficulties, both mechanical and electrical in nature. If records so obtained are to be of any real use, it is essential that they shall be reasonably free from error, to the extent, say, of one or two per cent., otherwise they will discredit either the transmitting or the recording station, making it impossible to reconcile the two, and will also be extremely likely to cause friction between the officials responsible for keeping the individual records at the respective stations.

An analysis of the sources of possible error usually reveals the fact that the two outstanding troubles are: voltage variation on the instrument supply line; and temperature changes, which will affect line and instrument resistance. Any "straight-through" circuit in which the records are dependent upon accurate measurements of current values are necessarily susceptible to two very serious errors arising from the above causes. Avoidance of the voltage error may be compassed by the "bridge" system of connection, whereby pressure variations merely affect the degree of control and not the actual readings, much on the same principle as that of the familiar ohmmeter. This still leaves temperature error to be dealt with, however, and in an all-copper circuit variations of climatic conditions can easily account for quite a serious percentage error in transmission to a distance, under extreme conditions of heat or cold. Much of this error can be eliminated by the use of a swamping resistance, consisting of some material with either a negative, or at any rate a negligible, temperature coefficient, whenever the general design of the scheme lends itself to this practice.



Figs. 2, 3, and 4.—The Transmitter, its Stator Parts, and Rotor.

In general, distant electrical records are required at the receiving station in three forms, *viz.*, as simple visible indications, diagrams or permanent records, or by some counting mechanism in the form of an integrating meter.

The large majority of devices used for transmission

to the distant receiving station depend for their operation on the presence of mercury in some part or another of their construction, changes in the value of the quantity under measurement causing a variation in the height of a mercury column in a U-tube, whereby the amount of ohmic resistance or the impedance of the circuit is altered. Sometimes this is accomplished by a series of fixed contacts of graduated length, " step " resistances being connected externally between the contacts, which are cut in and out by the rise and fall of the level of the mercury in which the contacts are immersed.

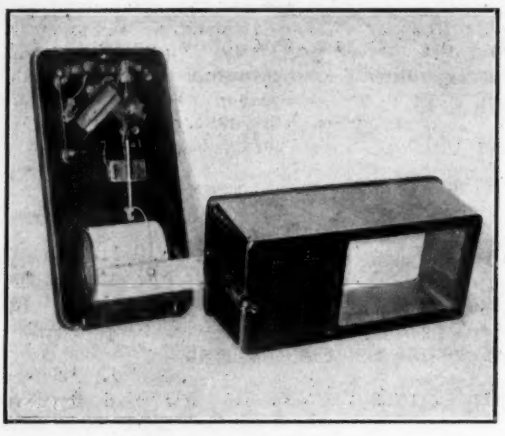


Fig. 5.—The Recorder.

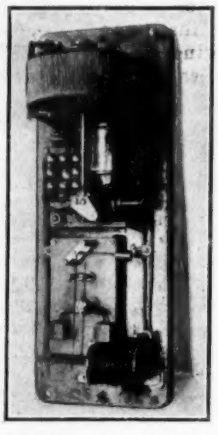


Fig. 6.—The Voltage Regulator.

In others a continuously graded resistance element is bodily immersed in one limb of a U-tube containing mercury, the rise and fall of the mercury level due to differential pressure on the two limbs of the tube " shorting " out to a greater or lesser extent the amount of included resistance, progressively and without steps.

Still another scheme is to cause the iron core of a choking coil to rise and fall with differences of level in the mercury tube, thus affecting the degree of choke in a suitably responsive circuit. The latter device is, of course, suitable for alternating circuits alone, but the two first described methods are equally applicable to direct current and to alternating current, providing the recording instruments are suitably chosen.

The objections to the use of mercury as a means of varying the value of the transmitted current to the receiving station are its liability to surface oxidation and consequent uncertainty of good contact, and the " meniscus " error. Owing to surface tension, the actual contact point is more or less unstable, and does not follow quite definitely the variations in pressure in the two limbs of the manometer tube. Added to this, great care is essential to choose materials upon which mercury has no chemical action, or amalgamation and erosion will, in time, occur. Very careful zero levelling of any apparatus depending upon the height of a mercury column for its transmission will also be needed.

Many possible errors due to such causes are avoided by the " Avery " telerecorder, which is essentially a " dry " system. Its action depends upon variable inductive effects in a transmitting coil situated in an alternating magnetic field. Any alteration of the plane of the rotor coil when it is within the influence of the stator field gives rise to inductive e.m.f.'s in the rotor windings proportional to the sine of the angle of rotation. Voltage values dependent upon the angular position of the rotor can then be transmitted to the distant receiving station with relatively small loss or error in transmission, owing to the minute current being dealt with. The uncertainty of mercurial contacts is eliminated; both the $C \times R$ drop and the C^2R losses are minimised, since the current and the resistance values are so small. When line-voltage fluctuation is present automatic voltage compensation can be provided.

The full electrical layout of the scheme is exhibited in fig. 1. Items at the receiving station not required in any particular circumstances can be omitted, replacing them with substitutional resistances. The full equipment consists of a static transformer having an independent earth-free secondary, wound for a standard voltage to suit all the instruments; the primary winding is designed to suit the supply voltage and frequency. This enables everything at the receiving station to be standardised. When a voltage regulator is also included in the equipment, the transformer is also provided with a tertiary low-voltage winding for operating a small motor forming part of the voltage-control device. Between the supply busbars, fed from the transformer secondary, and the instrument busbars, which supply the receiving instruments and transmitter, is introduced a small amount of non-inductive resistance for the purpose of bringing about an additional voltage-drop, the amount of which is automatically varied to compensate for any line fluctuations that may occur. This is accomplished in the following manner. A high-resistance voltage coil is supplied with current from the instrument busbars, and a balanced freely-pivoted laminated core inserted into the most sensitive portion of the coil. The iron core swings in and out with very small changes of applied voltage, and its movements bring down a copper fork into either one or another of two mercury cups forming part of the regulator motor circuit. This motor is of the series commutator type with right- and left-hand field windings, reversing its rotation according to whichever mercury contact is

Figs. 7 and 8.—The Integrator (top) and complete Recorder.

Fig. 9.—Transmitter and Prime Mover.

closed for the time being. The shaft projection of the motor carries a slow-motion worm reduction gear, causing a contact lever to traverse the non-inductive resistance which, as before mentioned, is inserted between the two sets of busbars, cutting in resistance when the voltage is high, and cutting it out when it falls. In practice this device has been found sensitive to the extent of a plus or minus correction of one volt in 250. The constant potential thus obtained at the instrument busbars is then applied to the stator windings of the transmitter, whose windings are also in series with the current coils of the intergrator.

The transmitter stator resembles a 2-pole laminated-field magnet with salient poles, between which is mounted the rotor on a vertical spindle with frictionless ball-thrust bearings. The shaping of the stator poles and the smooth core of the rotor lead to a practically uniform flux distribution in the airgap, resulting in an inductive e.m.f. which closely follows the sine law throughout the 65 degrees or so of rotation which is the permissible range of rotor operation. This feature, without being actually essential to performance, is of considerable value in practice, since it simplifies so much the forming of the cam which links the transmitter motion to the prime mover, and therefore simplifies calibration.

The indicator and recorder used in this scheme at the distant station consist of a commercial recording voltmeter movement, in which the usual clock-driven chart is supplemented by a subsidiary scale and pointer. Variations in voltage received from the transmitting station are recorded and indicated in whatever physical quantities may be required, instead of in voltage values, by calibration against known standards.

The integrator, or counter, resembles in construction the ordinary eddy-current type of watt-hour meter, having a light rotating disk mounted in spring jewelled pivots, driven by the eddy currents induced in it by two separate alternating-current magnets. One magnet has an almost entirely closed circuit, and is therefore but slightly affected by changes in excitation, while the other has an open magnetic circuit, responding freely to variations of current in its exciting coils. The closed-circuit magnet coil is in series with the stator winding of the transmitter, which is excited at constant e.m.f., and the current values in which change but very little throughout its operating range; it corresponds, in fact, to the usual "voltage coil" in the watt-hour meter. The open-circuit magnet is in series with the rotor winding of the transmitter as well as with the recorder-indicator coil, and it receives an impressed e.m.f. varying according to the angle through which the transmitter rotor has been turned. The usual functions of the commercial watt-hour meter have thus been reversed; instead of operating on constant voltage (nominally) and variable current, it operates with approximately constant current but at variable voltage.

Should the recorder not be required at the receiving station, a resistance is substituted of equivalent impedance to the working coil in the recorder. If the integrator is not wanted, but only the recorder, substitutional resistances are provided of equivalent value to the respective coils in the watt-hour meter, so that standardisation of the circuit as a whole is preserved. When small percentage errors are admissible and the supply voltage is reasonably steady, the voltage regu lator is an item that can satisfactorily be dispensed with.

When the recorder diagram is of secondary import ance to the counter, as would usually be the case, a very close degree of accuracy can still be preserved in the integrator by providing it with an electro-magnetic brake acting on the rotating disk, instead of the usual permanent magnet brake, and exciting it from the line voltage. If the induction in the brake magnet cores is kept low their flux responds readily to variations in the exciting coils due to line-voltage changes. The resulting braking effect being greater or less in like degree then affords a natural and automatitc correction to the speed of the integrator disk.

Fig. 9 is a view of the complete transmitter coupled to the prime mover, which in this instance is a steam-flow meter of a well-known make. The assembled transmitter is shown separately in fig. 2, which also shows the bevel gear at the top by which motion can be imparted to the rotor from any convenient apparatus responding to the quantity to be measured. Fig. 3 is an interior view of the transmitter stator, while the rotor is separately shown in fig. 4. The counter or integrator (fig. 6) is of a well-known commercial type, adapted for the purpose by special windings and inverted functions, as explained previously. The indicator and diagram recorder are to be seen complete in fig. 8, while the internal parts are exhibited in fig. 5. Internal details of the voltage regulator appear in fig. 6.

Joints for Aluminium Bus-bars.

By W. E. WARNER.

ALUMINIUM bus-bars are now used to some extent as a substitute for copper, and have been found satisfactory. The most favoured type of joint for joining two lengths of bus-bar is the bolted one, but to be efficient such joints must be carefully made, both as regards overlap and avoidance of the film of oxide which rapidly forms on this metal. A lap joint should be employed, using external clamps to hold it together, as direct bolting would make it necessary to drill holes in the bus-bar, which would reduce its section and increase its resistance. The amount by which the two bars overlap is also important: if the length of overlap is very large, compared with the thickness of the bar, the resistance at the joint will be nearly equal to the resistance which would be offered by the two bars in parallel. If the overlap is reduced, the resistance is increased. The width of the bar does not affect the resistance, provided both bars are of equal width. The increase in resistance is due to distortion as the current passes between the two bars, and the distortion depends on the ratio of the overlap to the thickness of the bars. If the overlap is equal to ten times the thickness of the bars, the increase in resistance due to distortion is only some 4 per cent.; if the overlap is only four times the thickness, that figure is increased to 20 per cent.; and if only twice the thickness to 50 per cent. In practice the overlap should be at least ten or twelve times the thickness of the bars. The contact resistance between the bars depends on the pressure with which they are clamped together, and the condition of the two aluminium surfaces. A film of oxide having a high electrical resistance quickly forms on clean aluminium surfaces, but may be prevented by cleaning the surfaces and bolting the bars together under paraffin oil; or by coating the surfaces with vaseline, rough filing them, and then immediately bolting them together, leaving the dirty vaseline on the surfaces. Either of these methods will prevent an oxide film forming; the first named is the more suitable for the laboratory, the last for practical purposes. The dirty vaseline does not interfere with the efficiency of the joint. For clamping, two plates should be used, one on each side of the joint, secured by bolts round the outside. As high a clamping pressure should be used as the bolts will stand. An efficient joint is one in which the resistance of the length of the joint is not in excess, or much in excess, of the resistance of an equal length of straight conductor. The efficiency of the joint can be found by testing the voltage drop across it with a milli-voltmeter and comparing it with the voltage drop across an equal length of straight conductor. If the joint has been properly made, the voltage drops should be similar. The temperature rise at the joint should not be so great as along the rest of the conductor, owing to the greater radiating area. The outside of the joint should be painted to exclude moisture.

Reviews.

Pitman's Technical Dictionary of Engineering and Industrial Science in Seven Languages—English, French, Spanish, Italian, Portuguese, Russian and German. Compiled by ERNEST SLATER, M.I.E.E., M.I.Mech.E.; in four volumes. London: Sir Isaac Pitman & Sons, Ltd. Price £8 8 0.

Anyone interested in technical translation work cannot fail to agree with Mr. Slater, who has been responsible for the compilation of Pitman's Technical Dictionary, that it has been the work of many years, and it may be said at once that it is the most comprehensive work of the kind that has so far been undertaken in any of the English-speaking countries. The latter phrase is used designedly, for it is well-known that for technical dictionaries it has hitherto been largely necessary to rely on German compilations. This is not mentioned with any derogative intention against the latter, for just as it is true that Mr. Slater has been at pains to secure the collaboration of men well-versed in the technical terms of the different languages, so equally is it true of the principal dictionaries which have emanated from Germany.

It is, of course, impossible to base this review on a close examination of all the four volumes into which Pitman's Dictionary is divided, but, regarding it as typical of the remaining three, the reviewer has given a careful study to the first volume, which, beginning with "A," extends as far as the word "Deck." The first volume is, however, all the more valuable in that its first sixty odd pages are devoted to an explanation of the methods adopted in the whole dictionary, and of the abbreviations used. There is also an article on "The Art of Technical Translation" which should prove extremely helpful to all who have translating work to do. The reviewer is one of these, and thoroughly agrees with the compiler that it is just as impossible for an English translator to produce, say, a perfect-Italian Italian translation as it is for an Italian to compile a correct-English English one. Where faultless translations are necessary, the only way, although it adds to the cost, is, as Mr. Slater suggests, that of collaboration between an Englishman and a native of the country of the desired language, both with a good knowledge of the particular trade or industry which is in question.

Following the article on translation is a section on "Alternative and Peculiar Phrases," one on "Adopted Words," and one on the "Idiomatic Use of Prepositions and Common Phrases, &c.," this portion being divided into sub-sections, one for each of the languages covered by the dictionary, the range of which it may, incidentally, be mentioned is wider than usual, in that it includes Portuguese. Finally, before getting to the dictionary proper there are seven pages which form a guide to common engineering abbreviations. All these sections contain information, a careful study of which cannot fail to be of great assistance to translators.

Coming now to the dictionary proper, its comprehensive character is indicated by the fact that it is designed to meet the requirements of over thirty trades and industries, ranging from aeroplanes to wood-working, automobile, civil, electrical and mechanical engineering being all, of course, embraced. The plan adopted is that of spreading the seven languages over two facing pages, the order being—English, French, Spanish, Italian, Portugese, Russian and German. The main English word is printed in bold type, while below it in smaller type are the various forms and phrases in connection with which the word is used. Thus, taking as an example the word "accumulator," the various terms in which this word is employed, both electrically and mechanically, extend to over a column of English, *i.e.* altogether to over two pages. The reviewer claims to have a good technical knowledge, in addition to English, of three of the foreign languages, and, with the exception of Russian, a smattering of the others, and hence is able to testify to the excellence of the translations, albeit, curiously enough in the "accumulator" example taken haphazardly the name "Planté" is mis-spelt "Plantz." As to the Russian, although not in a position to criticise this, it may be taken for granted that as great care has been taken with it as has obviously been the case with the others.

The reviewer is at present particularly interested in automobile as well as electrical terms, so naturally also gave these a little attention. Thus, taking the word "Axle," it is found that the phrases connected with this again occupy over two pages, the only criticism offered here being that the much used English word "Stub-axle" is not given, and although its equivalents in some of the languages appear, they would hardly be recognisable under the English phrase "axle neck or journal." Then, too, in connection with brakes, a German phrase recently encountered. "saugluft-bremsen," and the nowadays common English motoring term "servo-brake" are not mentioned. Although drawing attention to these details, it is of course realised that however comprehensive a dictionary may be it is not possible to include everything without making the work more bulky—and more costly.

The reviewer has, however, one great regret to express in connection with the work, and it is that the result of such a long, painstaking task should be confined to the relative limited use of translating technical English into foreign languages. Both commercially and technically there is practically as much need of a dictionary that will enable English people engaged in any of the industries covered by the work to translate into English the inquiries and communications they receive from abroad, and to study at first hand the many instructive articles appearing in the foreign technical press. Therefore one wonders whether the arrangement adopted is the best that could have been chosen, and whether by another plan it could not have been rendered equally valuable for translating foreign languages to English as it is for converting English to foreign, thus not only doubling its value to English users, but also of rendering it a world-wide, instead of merely a one-nation, dictionary. One is led to this remark by noting that considerable space in the whole four volumes of the Pitman's Dictionary is, if not to say wasted, at least taken up by repeating the English column twice—once on each facing page. One well-known German six-language technical dictionary is made available for use in any country, and for translating into, as well as from, any one language by dividing the work into two parts—one in which the terms in the different languages are grouped together, and a second one in which the words of all the languages—with the exception of Russian, for which, owing to the different letter characters, a special list has to be given—are alphabetically arranged in one extensive index.

To conclude, it may be repeated that any criticisms we have offered are not made in a carping spirit, and that as it stands the new Pitman's Dictionary is the most complete and up-to-date English work of its kind, and should prove invaluable to all who are called upon to undertake technical translation work.

C.J.W.

Electric Overhead Travelling Crane Design. By WILFRED A. BARSON. Pp. vii+120; figs. 41; tables xi. London: Crosby Lockwood & Son. Price 15s. net.

The rapid growth in the use of electrical energy and the stimulus imparted to this growth by the recent inauguration of supply on a national basis, are attributable to the advantages which electric power possesses over other forms of power in many applications. As regards its application to overhead travelling cranes, the advantages in favour of electricity, the outstanding developments and the substantial progress made during the last few years are very great. That there is scope for technical literation on electrical crane design will be freely admitted. The number of existing books dealing with the electrical engineering aspects of cranes is limited, and interest cannot fail to be aroused by the publication of a new volume on the subject.

The subject matter of this volume deals with the general arrangement of electrical overhead-crane design, bridge and crab design, electrical equipment, wiring and load attachments. A good deal of attention is given to the general designs and arrangements of crabs, motor and gearing, rope reeving and transverse machinery arrangement. Dealing with cranes running on alternating current supply, and where lowering is carried out through the motor (*i.e.*, no gravity lowering gear is fitted), the author advocates the discarding of the speed governor, as the characteristics of the motors are such as will not permit the load to race, and the lowering speed will never be much in excess of the hoisting speed. Upon the whole, the work is well done and the treatment of the subject is adequate; that the chapter on load attachments is not quite as clear as might be wished is due less to the fault of the author than to the extreme complexity of the subject and to the want of agreement amongst the leading authorities as to the interpretation to be assigned to the enormous mass of observed facts. A certain proportion of the matter is naturally not altogether new; some of it is to be found in very similar form in textbooks on the subject. The best chapters in the book are those which deal with electrical equipment and load attachments, reference being made to the types of motors used, controllers, resistances, brake solenoids, and grabbing and magnet cranes.

So many factors enter into the costs of electric overhead-crane design that the engineer, or the prospective purchaser, will base his estimates on the ascertained costs of actual work carried out under conditions similar to those he is preparing to undertake, if he is fortunate enough to have access to such data, rather than rely on reported data and current consumption. In a technical book of this class, comparative operating costs of various types and designs of electrical cranes might well have been included, and would have added considerably to the value of the volume. In the appendix, several tables are given in graphical form, the more important of which deal with leading dimensions and clearances, maximum loads per tramwheel of cranes, weights per pair of fish-bellied plate and lattice braced box main girders, and the dimensions, construction and breaking loads of flexible steel-wire load ropes with hemp main cores. Fig. 41 (p. 101) shows a diagrammatic arrangement of the equipment and connections for a lifting magnet crane running in a three-phase alternating current supply. For electric lifting magnet service it is essential that a direct current supply be available for excitation of the magnet. If the crane is running on alternating current supply, it is necessary to fix on the crane a motor-generator set, consisting of a squirrel-cage motor coupled to a direct current generator of suitable capacity for the magnet. The motor-generator set necessitates the fitting of a motor starter for the motor, and a shunt regulator for the dynamo, both of which should be fitted in the control cabin on the

switchboard. The lifting capacity of a magnet depends on the type of load lifted, and it will be realised, therefore, that the crane has no protection against overload, and the author strongly recommends that magnet cranes be rather more generously designed, after the manner of "heavy cranes," than is the case with ordinary service cranes.

It may be granted that considering the limited space at his disposal, the author has done his work remarkably well, but it is to be feared that the book will hardly prove so satisfactory "from the standpoint of the practical engineer" as from that of the less expert reader, whose object is to obtain a general acquaintance with the subject described.

Throughout the book, the illustrations are excellent, the line diagrams especially being commendably clear. The young engineer will undoubtedly find much that is useful to him in this book.

General Physics. By E. S. FERRY. Pp. xix+839; figs. 604. London: Chapman & Hall, Ltd. Price 20s. net.

The expression "general physics" is usually understood in this country to mean a rather wide survey of the mechanical properties of matter. Professor Ferry uses it here in the less usual but more rational sense of an account of the whole range of physics, and as he indicates in the sub-title, very properly insists on its bearing on problems *outside* of the teaching or research laboratory. The present volume is a third edition, and, with the appearance of the first edition dating back only to 1921, it must be evident that it is of no little merit.

His first section is upon dynamics (or using again our equivalent, mechanics) and strikes a good balance between the elementary mathematical formulation that is so essential in this and the bearing of the results upon the operation of machinery, and so forth. We note the inclusion of sub-sections dealing with friction, angular motion, gravitation, and upon wave-motion; the occurrence of the latter at this stage facilitates very greatly the subsequent study of the special types of wave-motion that constitute sound and electromagnetic radiation. Sound itself occupies the second section, of thirty-six pages, which is about its due in a text-book of this size. Heat follows, in three sub-sections, on the effects of heat, the propagation of heat, and thermodynamics. We notice particularly under the latter head a treatment of the second law, extending clearly but without undue analytical rigour to the definition and experimental realisation of the absolute scale of temperature.

The remainder of the book deals with electricity and magnetism, and light. Magnetism, electrostatics, the laws of flow of a steady current and their applications follow in the usual order, and from these the student is taken on to electromagnetic induction, being first introduced to the fundamental laws of Faraday, Henry, and Lenz, and then given a very good account indeed of electrical machines, well illustrated by diagrams and pictures in perspective. The section concludes with one short chapter on the electron theory, and another on the physical principles of radio. The photoelectric effect finds a place in the last chapter of the book, but is preceded by the main chapters on light, the general tenor of which is physical rather than geometrical, the first statement made in this connection being "Light is a Wave Motion." Thick lenses and lens systems are treated in some detail, as is indeed proper, the thin lens being an unattainable ideal, and there are taken as examples of optical instruments the human eye, the camera, the telescope and microscope, and the spectroscope; the remaining chapters are upon diffraction and scattering, colour sensation, and double refraction. They call for no special comment except for the inclusion of the doubtless valuable but somewhat unusual sections 486 and 487, on what can be best described as the theory of feminine make-up!

The general standard of work to which this book conforms is a little higher than that of the usual intermediate university examination; it should be useful to students who are preparing for such, in particular those who are working "externally" without the aid of a teacher, who will find the sixteen hundred odd numerical problems at the end a great help in fixing formulæ in their minds. It should be equally valuable for use in the upper forms of schools for students who are not proceeding farther with the subject; scholarship candidates will, however, find it inadequate in mathematical detail.

Heaviside's Operational Calculus as Applied to Engineering and Physics. By ERNST JULIUS BERG, Sc.D., Professor of Electrical Engineering, Union College. Pp. xiii+214; figs. 65. London: McGraw-Hill Publishing Co., Ltd. Price 15s. net.

The present volume, which is one of several that have appeared recently upon Heaviside's methods, will already be familiar to many readers of this journal in substance, being based upon a series of articles by the author in the *General Electric Review* for 1927 and 1928. It is essentially a handbook for the practical man, for although a mathematical treatise almost from one cover to the other, the problems dealt which are, apart from a solitary exception on the flow of heat, those which are perhaps the most fundamental of all to the electrical engineer—the properties of conducting networks and cables. At the same time, Professor Berg has not assumed any special knowledge of mathematics on the part of the reader, who will find here actually material which should be of service in very different connections, in, for example, the chapter on the numerical solution of algebraic and transcendental equations (XXVIII), contributed by Mr. S. J. Haefner.

Very particular interest attaches to the sketch of Oliver Heaviside, which appears as a preface. Heaviside was known to the author personally, and he has recorded his impressions of him with admirable feeling. In many respects he must have been like that earlier erratic genius Cavendish. He lived for many years alone, and his main contact with the world was through the medium of a man—a policeman—who brought him his supplies. He was something of an artist, keenly appreciating the beauty of his surroundings at Torquay, a lover of good literature, and a prolific writer of letters, as well, of course, as of scientific work. He made too his own pens and ink. Dr. Berg noticed that after his first visit he was received with newspapers spread over the stair carpets; and Heaviside was equally meticulous as to his personal appearance. Of biographical data there are practically none known, but it is interesting, and perhaps significant, that he was a nephew of Wheatstone.

The progressive recognition of the value of Heaviside's apparently unorthodox methods is well illustrated by Dr. Berg's statement that he has taught them at first only to graduate students, then later to his senior class of electrical engineers, and now in the last few years to juniors as well. He writes with this experience behind him, and his book is one which should be in the possession of all who are actively interested in electricity.

Legal.

Symphony Gramophone & Radio Co., Ltd.

MR. JUSTICE MAUGHAM, in the Companies' Court on January 20th, had before him the petition of the Plessey Co., Ltd., electrical engineers, Vicarage Lane, Ilford, for an order for the compulsory liquidation of the Symphony Gramophone and Radio Co., Ltd.

For the petitioners, Mr. ARCHER, K.C., said that the respondent company was at the moment insolvent but at a creditors' meeting on January 15th a resolution was passed suggesting a long adjournment of the petition. The petitioners were creditors in dishonoured bills for £4,000 and for £25,000 for wireless goods supplied under contract. They would not object to an adjournment if the goods which they had made for the respondent company but which had not been delivered owing to the company being behind with its payments, could be sold by somebody under the company's control or by the petitioners themselves.

Mr. GEDGE, for the respondent company, said the plea for adjournment was supported by creditors for £5,200, and he suggested three weeks.

Mr. ARCHER asked if there was a prospect of his clients getting cash, and if not whether they would be able to sell promptly, as wireless goods "went out of fashion so quickly."

The petition was adjourned for a week.

The Hull Tramways Dispute.

IN the Chancery Division on January 17th, before Mr. Justice Luxmoore, the Hull Corporation agreed to continue its undertaking not to dismiss certain employés until the trial of the action which is being taken by those employés. The men concerned were engaged during the general strike of 1926 and the Corporation proposes to terminate their engagements, giving them the option of rejoining the Tramway Department in the lowest grades, on the ground that their presence has caused disaffection in the Department.

Mr. Justice Luxmoore gave the parties leave to apply for a speedy trial of the action.

Electricity Supply in U.S.A. during 1929.

The *Electrical World* in its review of progress during 1929 of electricity supply in the U.S.A., gives the following particulars: The number of kWh generated, including the output of railway power stations, increased by 12 per cent. to 94,337,000,000, of which 36.4 per cent. was produced by hydro-electric plants. The gross revenue was increased by about 8 per cent. to some £35,000,000. Operating expenses (excluding capital charges and taxes) amounted to 45 per cent. of the revenue. The output per head was 815 kWh and the corresponding revenue £3 12s. 3d. After deducting losses in distribution and inter-company sales, 77¼ million kWh was sold to consumers in the approximate ratios for lighting, power, and railways of 26.2, 65.1, and 8.7 respectively. The number of consumers amounted to more than 24 million, of which 80 per cent. were residential. It is estimated that 70 per cent. of the houses have electric service and that no towns of more than 2,500 inhabitants are without a supply. American manufacturers are said to be adding to the plant operated by electricity from public sources at the rate of one million h.p. per annum.

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The Funeral of Mr. H. Alabaster.

THE remains of the late Mr. Henry Alabaster were laid to rest at Brookwood Cemetery on the afternoon of Thursday, January 16th. A service was held in the Church of England Chapel.

The family mourners included Mr. G. H. Alabaster (son), Mrs Duncan Lyle (daughter) and Dr. Lyle, and Mr. George Tardrew.

The ELECTRICAL REVIEW was represented by Mr. E. A. Gatehouse (one of the managing directors); Mr. E. S. Middleton (secretary and director); Mr. J. E. Kingsbury (director); and Mr. H. R. Kempe. Indisposition prevented the presence of Mr. A. H. Bridge (commercial editor and director) and Mr. H. Porter Cox (advertisement representative). Messrs. P. J. Haskell and Arthur Cox represented the Advertisement Department. Others included Mr. W. B. Warwick (the Engraving Department); Mr. J. Elliott (manager and secretary of the Premier Linotyping & Printing Co., Ltd.); and Messrs. W. H. Wicken and W. J. Palmer (the Composing Department).

There were also among the company assembled the following:—

Mr. Ll. B. Atkinson; Mr. H. Church; Mr. W. R. Rawlings (First President of the Electrical Contractors' Association); Mr. W. A. Jones (general secretary of the Electrical Power Engineers' Association); Mr. W. E. Lane (secretary of the late Electro-Harmonic Society); Mr. H. F. Parker (secretary of the Lloyd Memorial (Caxton) Seaside Home); Mr. C. W. Clark (Callender's Cable & Construction Co., Ltd.); Mr. A. M. Sillar; Mr. Frank Harris; Mr. J. M. G. Trezise; Mr. W. E. Dedrick; Mr. and Mrs. Henderson; Mr. T. Rich; Mr. P. V. McMahon; Mr. G. H. Southall; Mr. Walter Landells; Mr. R. W. Hughman (*Electrical Times*); Major F. H. Masters (*Engineering*); Mr. Lepper (*Electrician*).

Floral tributes were sent by the following:—

Mrs. Henry Alabaster; Mr. Geoffrey H. Alabaster; Dr. and Mrs. J. Duncan Lyle; Mrs. G. H. Alabaster; Audrey, Margery and Ian Alabaster; Sonia Lyle; the Misses M. and J. Alabaster and Miss Debney; Mr. A. W. Alabaster and daughters; Mr. Robert Alabaster and Mrs. Clara Moore; Mrs. James Lyle; Mrs. Moutrie and Mrs. Isenman; Mr. and Mrs. Ernest Gatehouse; Mrs. Helen Gatehouse and family; Mr. and Mrs. J. E. Kingsbury and family; Mr. E. S. Middleton; Mr. Albert H. Bridge; Mr. C. O. Brettelle; Mr. H. Porter-Cox; Mrs. Allen and family; Mr. and Mrs. Jack Elliott; Mr. and Mrs. W. E. Dedrick; the ELECTRICAL REVIEW Staff at Ludgate Hill; the Composing Staff of the ELECTRICAL REVIEW; the Office, Printing and Warehouse Staffs of the Premier Linotype & Printing Co., Ltd.; the Warehouse Chapel of the Premier Printing Co.; Mr. A. Hilder (chauffeur); the staff of Mr. G. H. Alabaster at West Hill; the Worshipful Master, Wardens and Brethren of the Electric Lodge (No. 2,087); the Staff of the *Electrical Times*; the Directors of the Electrical Press, Ltd.; the Directors of the General Electric Co., Ltd.; Sir Hugo Hirst, Bt.; Mr. M. J. Railing; the Chairman and Directors of Callender's Cable and Construction Co., Ltd.; Sir Tom and Lady Callender; the Electrical Contractors' Association; the President and Members of the Electrical Power Engineers' Association; the Directors of Morgan Bros. (Publishers), Ltd.; Mr. and Mrs. Ll. B. Atkinson; Mr. A. M. Sillar; Mr. J. M. G. Trezise; Mrs. Robert Church; Mr. and Mrs. Herbert Church; Mr. and Mrs. W. Jennison; Mrs. Phillips Page and Ruth; Mr. and Mrs. George Tardrew; Mr. and Mrs. R. L. Henderson; Mrs. Lander King; Mr. and Mrs. George Southall; Mr. and Mrs. Charles Higgens; Mr. and Mrs. Brian Passmore; Mr. and Mrs. Reggie Wigg; Mr. and Mrs. Frank Harris; Mr. and Mrs. George H. Redwood and Family; Mr. Geoffrey Craster; Mr. R. G. Craster and Mr. E. A. Burton; Mr. and Mrs. Sanderson; Basil Sanderson; and "Friends at Selsdon Park."

On behalf of Mrs. Henry Alabaster and members of the family, as well as on our own behalf, we desire to acknowledge with gratitude, the receipt of over 200 letters of sympathy in which many electrical associations, organisations, also business and personal friends, have paid tribute to the life and work of the late Mr. Alabaster.

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations, and Failures.

Hackney Prefers British Plant.

Under this heading in our last issue (p. 115) we reported the decision of the Hackney Electricity Committee to recommend the Borough Council to accept a British tender for a 30,000-kW turbo-alternator and accessories although the price was considerably higher than that at which a German set was offered. At its meeting on Wednesday last week the Council accepted the recommendation after some discussion.

The contract in question was one of five for power station buildings and plant, and, according to the *North London Recorder*, the leader of the Labour representatives on the Council (Councillor H. E. Goodrich) moved the reference back of the Electricity Committee's report on the ground that if the contracts had been dealt with under one head there would have been a large saving in contingencies and provisional expenses. He said that if one contract was delayed the whole of the work might be held up, and they could only be reimbursed on one penalty clause. Referring back to the figures for the work considered in 1928, he said that had it been done then there would have been a saving of £20,000. If the matter had been conducted on business lines there would have been a total saving of £68,000. Councillor Goodrich emphasised his opinion that the work should be done by a British firm, but he moved the reference back on purely business lines.

Alderman J. Genese said that the Committee had done its best. Their officials would keep their eyes upon the spending of money on contingencies, and there was nothing to be afraid of. No doubt the cost of materials had gone up since 1928.

Alderman W. J. Stapleton (chairman of the Electricity Committee) said that the tenders were the very best that they could submit. The contingency amounts were only 4 per cent. of the total involved, and they were necessary. The Committee had obeyed the Council's instructions in splitting up the work into five contracts. He appealed to the Council to trust the Committee a little more.

Employment during December.

The January *Ministry of Labour Gazette* says that employment in the engineering industry remained slack on the whole during December, and showed little general change as compared with the previous month. In electrical engineering employment was still fairly good. The number of unemployed in the engineering industry rose from 90,594 to 90,918, and the percentage from 9.0 to 9.1. There was a decline in unemployment in the electrical engineering section—from 3,583 to 3,519, but the proportion remained at 4.2 per cent. In the electric cable, wire and lamp manufacturing group there was little change; the number of unemployed decreased from 4,214 to 4,202, the percentage remaining at 4.5. There was a considerable improvement in the electrical wiring and contracting industry. The number of unemployed fell from 1,223 to 955, reducing the proportion from 7.4 to 5.7 per cent.

The E.D.A. February Programme.

The accompanying illustration is reproduced from the February programme of the British Electrical Development Association, and strikes a modernised note. The background is in black and yellow crepe paper, and the figure is a life-size cut-out of the one which appears in all E.D.A. advertisements and in the Campaign poster. The cubes are covered with green crepe paper and three ½-in. strips of yellow paper wound diagonally around the top of each: the foreground is cut from green crepe paper. The programme also contains examples of the Electric Home (Outlet) Campaign advertisements appearing in the national Press during February, and an advertisement specially prepared for the use of electricity suppliers, contractors and dealers, for which complete stereos pierced for the insertion of the advertiser's name, address, &c., can be obtained from the Association. A coloured lantern slide of the "Plug in to Comfort" poster, designed to link up with local Press announcements, is also available. A list of publications for the month is given, and notes on the Outlet campaign are contributed by the director.

The E.D.A. Window Display for February.

The window displays planned by E.D.A. are very welcome to electrical dealers and others. Very effective use is made of simple materials and the results can rarely be bettered. We have had an opportunity of examining a photograph showing how a firm of electrical engineers and contractors made use of the January E.D.A. window lay-out. The display was illustrated in our issue of December 20th (p. 1095), and Messrs. Baily, Grundy & Barrett, Ltd., the engineers referred to, have found it very useful in dressing the windows of their new showrooms at Midhurst, Sussex. Messrs. Baily, Grundy and Barrett are engineers to the Midhurst & District Electricity Co.

The B.E.A. and Australian Tariffs.

The following resolution with reference to the recent heavy increases in Australian tariffs was recently passed by the Council of the British Engineers' Association, and it has been conveyed to the Australian authorities:—"The Council of the British Engineers' Association view with great concern the large increases in the Australian tariffs as affecting the products of engineering industry, and whilst recognising the unquestionable right of the Australian Commonwealth to determine its own economic policy, would venture to point out that trade is necessarily reciprocal, and that the extent to which this country can purchase the products of Australia must depend on the payments Australia is prepared to receive from this country in the form of manufactured articles which are our principal goods of exchange and of which the products of engineering and allied industry constitute a substantial proportion."

Power Station Staffs' Salaries.

In our issue of August 30th last (p. 354), we reproduced the National Joint Board schedule of salaries for power station staffs as it stood for the remainder of the year. We are informed that these rates are to continue in force until the end of June next.

Polish Foreign Electrical Trade.

The *Polish Economist* for January shows that during the first eleven months of last year Poland imported 3,885 tons of electrical machinery valued at 29,155,000 zloty (£672,000), as against 3,472 tons valued at 27,530,000 zl. (£634,000) in the corresponding period of 1928. The imports of "electrical wares" amounted to 11,110 tons, value 89,119,000 zl. (£2,053,000), as compared with 13,743 tons, value 85,817,000 zl. (£1,978,000) in the first eleven months of 1928. Polish exports of machinery and electrical appliances during the same period totalled 5,627 tons, valued at 15,616,000 zl. (£360,000), against 3,443 tons, value 7,816,000 zl. (£180,000).

Forecasting Business.

An address on "Research as Applied to Sales Forecasting" was given by Mr. William Wallace last week to members of the Business Research and Management Association of Great Britain. The speaker said that the economist could assist the business man by showing him how external affairs affected his business. Progressive businesses to-day proceeded according to a conscious plan. A business forecast was an attempt to foretell as accurately as possible the probable general trend of economic or business conditions in a certain field over a certain period. If past sales were analysed it would be found that there were three distinct types of variation. First, there was a seasonal variation peculiar to the industry. Then there was the long-period growth or decline of the business in relation partly to the general movement of the industry, and thirdly, there was a definite cyclical movement. It had been found that trade cycles could be forecast with some accuracy by studying speculation and the price of money. Business men could not rely upon any theory of forecasting as a substitute for judgment—it was only an aid to judgment.

Compensation for Displaced Employés.

The *Record*, the official journal of the Transport and General Workers' Union, reports that twelve members of the Union, until recently employed at the Strood generating station of the Kent Electric Power Co., have been awarded compensation following upon the closing down of the station in June, 1928. When the men were discharged, the Union claimed compensation for them under the Electricity (Supply) Act, 1919. The company repudiated liability, claiming that the bulk supply from Barking was the result of a domestic arrangement with the County of London Electric Supply Co. made in 1912. The company, however, agreed with the Joint Industrial Council for the Electricity Supply Industry to refer the matter to the Electricity Commissioners, who found in favour of the men and awarded them individual sums ranging from £71 to £389, the total amounting to £3,500.

Social Events.

The fourth annual staff dinner and dance of the Enfield Cable Works, Ltd., was held at the Midland Grand Hotel, St. Pancras Station, N.W.1, on January 18th, the Earl of Verulam, Chairman of the company, presiding. In proposing "The Enfield Cable Works, Ltd.," Dr. E. Bowden said that the staff had a definite place in industry and served to check a tendency of operatives to obtain the maximum amount of remuneration, and a tendency of directors to obtain maximum profits without the installation of up-to-date plant. He expressed the hope that the section of the industry which the company represented might regain the leading position it had held in the electrical industry. In responding, Mr. F. Plutte endorsed Dr. Bowden's remarks regarding the staff, technical and commercial, and agreed that the success of a firm was largely due to the co-operation of the staff. The Enfield Company depended a great deal upon its staff, both at home and abroad, for its orders. The toast of "Our Guests" was proposed by Mr. D. A. S. Porteous, and responded to by Mr. C. W. Glover. Mr. W. Fraser proposed "The Chairman." Musical items were rendered by members of the staff, and dancing concluded a very pleasant evening.

The annual staff party of Messrs. Ferguson, Pailin, Ltd., was held in the company's dining rooms, Higher Openshaw, Manchester, on January 11th. Tea was served to 350 guests and was followed by an exhibition of acrobatic and character dancing. The rest of the evening was spent in dancing by the guests, and a pantomime by Mr. George Pailin, based on the story of "Dick Whittington." The function, which proved a great success, was presided over by Mr. Samuel Ferguson and Mr. George Pailin.

Mr. A. Cozens, of Sunninghill, again entertained his electrical staff and friends to a New Year's party and dance, at the Cordes' Hall, Sunninghill, on January 10th. Nearly 200 were present, including representatives of the Clacton, Camberley, and Henley branches. Dancing commenced at 8 o'clock, and was followed by an excellent entertainment rendered by Betty Weldon's London concert party. Supper was served at 10.45 p.m., and more dancing followed. During the evening a bouquet of carnations was presented to Mrs. Cozens as a mark of appreciation from the employés.

Belgian Philips Company to Move.

It is announced from Brussels that the Belgian Philips company has decided to remove from Brussels to Heverlee, near Liége. Large new factories are being built and the share capital is being raised from one million to 20,000,000 fr.

Bankruptcy Proceedings.

V. H. BATES, trading as "The Linton Radio Service," High Street, Linton, Cambridgeshire, wireless engineer.—The adjourned public examination herein was held recently at the Guildhall, Cambridge. According to the statement of affairs, there were liabilities amounting to £204, against assets of £56, leaving a deficiency of £148. In September, 1924, the debtor commenced business on his own account as a radio engineer and boot repairer at Harlow with a capital of £55 in cash. This business was mainly wireless, but the greater amount of the profit came from boot repairing. In March, 1923, he sold his business at Harlow and opened a business in conjunction with his father at Linton. It was understood that his father would hand the Linton business over to him, but this he had failed to do. Debtor sold the business at Harlow for £140, and all the liabilities had been discharged except one. Debtor attributed his failure to changing from Harlow to Linton, expenditure on buildings and plant at Linton, and insufficient profit. The examination was adjourned.

T. W. B. DURANT, electrical and motor engineer, Coib Lane, Chapeltown, Sheffield.—Receiving order made January 10th on debtor's own petition.

W. H. QUINTRELL, electrical and mechanical engineer, Higher East Street, St. Columb Minor, Cornwall.—Receiving order made January 10th on debtor's own petition.—First meeting January 24th, at the Official Receiver's offices, 12, Princess Street, Truro. Public examination February 3rd, at the Town Hall, Truro.

J. CROOK (W. & J. CROOK), wireless engineer, 5, Crosby Street, Atherton.—First meeting held January 22nd at the Court House, Bolton. Public examination March 11th at the Court House, Bolton.

J. P. HAYES (EVENING WORLD GRAMOPHONE STORES AND SERVICE), radio electrician, 17, Lawrence Hill, Bristol.—First meeting January 24th at the Official Receiver's offices, 26, Baldwin Street, Bristol; public examination January 31st at the Guildhall, Bristol.

J. DEAN, electrician, 4, Gogerddan Place, Aberystwyth.—Last day for proofs for dividend January 28th. Trustee, Mr. H. W. Thomas, 4, Queen Street, Carmarthen.

E. W. BLAIR, electrical engineer and contractor, 6, Queen's Parade, Brent Street, Hendon.—First and final dividend of 7s. 2d. in the £ payable at the Official Receiver's office, 29, Russell Square, W.C.1.

D. W. MORPHY, manufacturer of wireless apparatus, 4 & 5, Dorset Mews, North Upper Gloucester Place, N.W.1.—Receiving order made January 15th on debtor's own petition. First meeting January 28th. Public examination March 7th. Both at Carey Street, W.C.

R. J. IRVING (R. Irving), wireless dealer, 4, Bridge Road, Kirkstall, Leeds.—Receiving order made January 11th, on debtor's own petition.

E. R. MILLWARD (West of England Radio), wireless engineer, 67, High Street, Barnstaple.—Last day for proofs for dividend February 1st. Trustee, Mr. W. R. Cocks, Official Receiver, Exeter Bank Chambers, Broadgate, Exeter.

S. E. HUNT, electrical engineer and contractor, 8a, Torwood Street, Torquay.—Last day for proofs for dividend, January 31st. Trustee, Mr. E. H. Hawkins, 4, Charterhouse Square, E.C.

E. A. WARNES (Victoria Radio Co. and E. A. Warnes & Co.), 10, Crescent Gate, Wilmslow, Rusholme, Manchester.—Last day for proofs for dividend, January 31st. Trustee, Mr. A. T. Eaves, 47, Mosley Street, Manchester.

Company Liquidations.

RHAYADER ELECTRIC LIGHT & POWER CO., LTD.—Particulars of claims to the Liquidator, Mr. J. Stephenson, Victoria Hall, Llandrindod Wells, by January 31st.

PRESTEIGN ELECTRIC COMPANY, LTD.—Particulars of claims by January 31st, to the Liquidator, Mr. J. Stephenson, Victoria Hall, Llandrindod Wells.

DONARELLI PHONO-ELECTRON, LTD.—Winding up voluntarily. Liquidator, Mr. H. H. Gay, 74, Cheapside, E.C.

ANDERSON'S WIRELESS SALES AGENCY.—Winding up voluntarily. Liquidator, Mr. W. G. Dunn, 11, Great Turnstile, High Holborn, W.C.1.

CLEARTRON RADIO, LTD.—A meeting of members is called for February 19th, at 9, Bedford Road, W.C., to hear an account of the winding up from the Liquidator, Mr. C. A. Worssam.

MANCHESTER PRIVATE TELEPHONE & ELECTRIC LIGHTING CO., LTD.—Liquidator, Mr. J. R. Atkins, 14, St. Anne Square, Manchester, appointed January 6th.

The Necessity for Foreign Markets.

Speaking at the annual meeting of the British Export Society last week, Sir Arthur Duckham (president) said that we could not rely entirely upon the Dominions to absorb our products. The world was our dominion in the matter of export trade, and we had a reputation in foreign markets which was the highest in the world.

Private Arrangements.

SYMPHONY GRAMOPHONE & RADIO CO., LTD., 23/24, Warwick Street, and 10, 12, and 14, Beak Street, Regent Street, W.—A meeting of creditors was held on January 15th when Sir Arthur H. Holbrook, chairman presided. Mr. Davies, of the D. M. Davies Woodwork Co., Ltd., creditors for approximately £10,000, stated that he and others had been in consultation with Sir Arthur Holbrook and other directors of the company with a view to formulating a scheme to be submitted to the creditors. It appeared clear that further capital would have to be raised, and as a result of negotiations, the chairman was in a position to state that a sum of between £20,000 and £30,000 additional capital could be obtained, which would be secured by the issue of first debentures. Mr. Davies was desirous that the creditors should agree to support an application to the Court for the adjournment of the petition, as he was satisfied that within 12 months the company would be able to discharge the amount due to its creditors. It was stated also that part of the scheme when drawn up would be that the creditors would receive payment on account upon assenting to the scheme. The creditors decided to support the application for the adjournment of the petition for a period of two months, and resolved that in the meantime a scheme should be formulated for the approval of the Court and submitted to the creditors and shareholders, and that an application should be made to the Court to restrain creditors from continuing proceedings against the company. A committee was appointed consisting of Mr. Davies, the representatives of the Chloride Electrical Storage Co., Ltd., the Six Sixty Radio Co., Mr. C. Latham (Wireless and Allied Trades Guardian Association), and Mr. F. E. Bendall, representing creditors, to confer with the company in connection with the preparation of the scheme.

H. O. WILKINSON, electrical engineer, 913, Brighton Road, Purley, Surrey.—A meeting of creditors was held recently when it was repored that the liabilities were £629 and the assets £1,172, or a surplus of £543, subject to the cost of realisation. It was stated that proceedings had already been commenced by certain creditors, and in order to avoid an execution being levied, it was decided that a deed of assignment should be executed with Mr. C. Latham, 78, New Oxford Street, W.C., as trustee, together with a committee consisting of the representatives of Auto Sundries, Ltd., Falk, Stadelman & Co., Ltd., and L.E.S. Distributors.

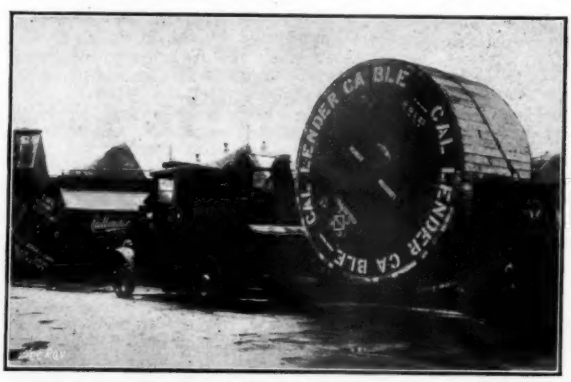
Dissolutions of Partnership.

KAY & MORRIS, electrical engineers, 176, North Road, Preston.—Mr. T. Kay and Mr. W. B. M. Morris have dissolved partnership. Mr. Kay will attend to debts and continue the business.

BRISTOW & Co., electrical engineers and lampshade manufacturers, 40, Sloane Street, 5, Maddox Street, 63, Buckingham Gate, 9, Pollen Street, and 21, Astwood Mews, London. Mr. L. Bristow and Mr. E. Bristow have dissolved partnership.

Callender Cable for Abroad.

The accompanying illustration shows a drum of cable, manufactured by Callender's Cable & Construction Co., Ltd., leaving



A Drum of Callender's Cable Ready for Shipment.

the company's works for shipment abroad. This is an exceptionally large one weighing over 22 tons.

Book Notices.

"Selektiv-schutzeinrichtungen fur Hochspannungsanlagen," by M. Walter. Munich and Berlin: R. Oldenbourg's Verlag, 1929. Price 7s.—This little work, in German, deals with the subject of selective protection devices for h.p. installations, and is an endeavour to explain the working of such devices and the principles underlying their design for the benefit of station engineers and electrical engineering students. The text, which extends to 134 pages, is elucidated by means of 77 illustrations and diagrams.

"*Journal* of the Institution of Electrical Engineers." Vol. LXVIII. January, 1930. London: E. & F. N. Spon, Ltd. Price 10s. 6d.

"Pioneers of Electrical Communication," by Rollo Appleyard. Pp. ix+347; illustrated. London: Macmillan & Co., Ltd. Price 21s. net.

"Motor Repair and Overhauling," edited by George T. Clarke, is being published in about 24 weekly parts, price 1s each. The first part was published on January 22nd. London: George Newnes, Ltd.

Trade Announcements.

With the prospect of a public supply of electricity for the district, Messrs. JAMES STEPHEN AND SONS, Main Street, Biggar, are opening a department in connection with their business for the supply of electrical goods and for the wiring of houses and shops. An electrical business is also to be opened at Biggar by the TWEEDALE MOTOR CO., LTD., of Peebles.

SUPERLAMP, LTD., has opened a new branch at 11 & 13, Union Street, Maidstone (telephone no.: Maidstone 953).

Mr. T. R. CALDICOTT, radio engineer, 37, Milsom Street, Bath, has disposed of his business to Bristol Wireless, Ltd.

Messrs. DAVIES & JONES, radio and electrical engineers, Ramsgate, have taken larger premises at 120, King Street.

The HENDERSON WIRELESS AND ELECTRICAL SERVICE, Brighton, has appointed Mr. C. F. Saunders, late of the Burgoyne Wireless Co. Ltd., as outside representative to cover the districts from Shoreham down to Bournemouth, through to Aldershot.

The Bristol branch of the GENERAL ELECTRIC CO., LTD., has been removed to "Magnet House," 24, Victoria Street, Bristol. Telephone: Bristol 9550 (three lines).

VAC-TRIC, LTD., has removed to a larger and more up-to-date factory in Waterloo Road, North Circular Road, Cricklewood, N.W.2. The telephone number and telegraphic address are unchanged.

WILD-BARFIELD ELECTRIC FURNACES, LTD., have entered into an agreement with Messrs. Gibbons Bros., Ltd., Dibdale Works, Dudley, for the manufacture of large "Wild-Barfield" industrial electric furnaces.

New Catalogues and Lists.

BRITISH DRIVER-HARRIS CO., LTD., 329, High Holborn, W.C.1.—A catalogue giving data and specifications pertaining to "Nichrome" and other alloys for electrical resistance.

MEECH ELECTRIC DRIVES, LTD., 19, 20, 21, Farringdon Street, E.C.4.—Illustrated leaflet No. 111, describing the company's push-button operated driving equipments for single- and multi-colour, perfector, and offset printing presses of the flat-bed and rotary patterns.

Mr. ALAN WRIGHT, 117, Victoria Street, S.W.1.—List No. C2/29, containing illustrated particulars of "Inventum" electric cisterns.

DRAYTON REGULATOR AND INSTRUMENT CO., LTD., West Drayton, Middlesex.—Lists Nos. 129 and 98b, dealing, respectively, with the "A.M. Junior" temperature regulator and the company's boiler water level controllers.

MARCONI'S WIRELESS TELEGRAPH CO., LTD., Marconi House, Strand, W.C.2.—Two descriptive pamphlets of the Marconi short-wave receiver, type R.g. 24, and the 10-watt portable short-wave set, type S.P.2.

Messrs. DAVEY, PAXMAN & Co., LTD., Aldwych House, Aldwych, W.C.2.—A pad of testimonials from various authorities regarding the running of the Paxman cold-starting "spring injection" oil engine.

GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—The January issue of the "Osram-G.E.C. Bulletin" contains many interesting articles, including particulars of the office illumination at the Underground Railway headquarters, lighting of pantomimes, electric heat in industry, &c.

WARDLE ENGINEERING CO., LTD., Elsinore Road, Old Trafford, Manchester.—An illustrated folder describing the "Maxheat" tubular electric radiator, specially designed for heating offices, &c. Also leaflet No. H.252, giving details of the "Maxheat" tubular electric heating system.

Messrs. DAVID BROWN & SONS (HUDDERSFIELD), LTD., Park Works, Lockwood, Huddersfield.—Technical data sheets Nos. 1110 and 1241, dealing, respectively, with the "Voran" front wheel drive and geared motor units (vertical type).

Messrs. DORMAN & SMITH, LTD., Manchester.—Leaflet No. L.110 drawing attention to ironclad switches and distribution boards supplied by the company to the Bengal Railway.

NEW SYSTEM PRIVATE TELEPHONES, LTD., 1, Arundel Street, Strand, W.C.2.—An illustrated leaflet outlining the advantages of "New System" private telephone installations.

Messrs. G. A. HARVEY & CO. (LONDON), LTD., Greenwich Metal Works, Woolwich Road, S.E.7.— A brochure containing illustrated particulars of riveted and electrically-welded work carried out by the company's Steel Plate Constructional Department.

Messrs. NEWTON & WRIGHT, LTD., 471-3, Hornsey Road, N.19.—An illustrated price list (publication No. E/29) of electro-medical apparatus, including galvanic and faradic batteries, switchboards, electro-medical tables, universal machines, &c.

REGANTS, LTD., 17, Shepherd's Bush Green, W.12.—An illustrated catalogue, including prices and dimensions of "Regant" lighting units, with a report upon a test made at Faraday House testing laboratories of four lighting units.

Messrs. MAVOR & COULSON, LTD., 47, Broad Street, Glasgow, S.E.—An illustrated and descriptive leaflet dealing with the company's 16-in. gear for driving electric shaker conveyors.

Unemployment.

The number of persons on the registers of the employment exchanges of Great Britain showed a decrease of 31,431 during the week ended January 6th. At that date the total was 1,478,800, as compared with 1,510,231 on December 30th, and 1,452,619 on January 7th, 1929.

American Lamp Sales in 1929.

Sales of incandescent lamps in the United States during 1929 were approximately 340,000,000 large and 292,000,000 small lamps. This is an increase of 18,000,000, or a little over 5½ per cent. in the large sizes compared with the previous year, and an increase of 37,000,000, or 14½ per cent. in the small sizes. These sales exceed all previous figures. On march 1st, 1929, 50- and 60-W standard lamps of the 115-V group were reduced in list price from 22 to 20 cents, so that the 20-cent price now covers all the generally-used lamps up to and including the 60-W size. The trend of prices has been downward for a number of years; the current prices are less than half the pre-war figure.

Industrial Administration.

The Institute of Industrial Administration, 47-51, King William Street, E.C.4, has completed a system of study for training for management, and is holding examinations in the knowledge which should be common to management in all industries. The syllabuses of the examination scheme for the diploma of industrial administration cover a wide range, including economic theory, introduction to industrial administration, sales policy and administration, costing and management statistics, social factors and industry, and many other subjects. The chairman of the Board of Examiners is Mr. H. Schofield, and the hon. director is Mr. E. T. Elbourne.

Recent Contracts.

Messrs. VICKERS-ARMSTRONGS LTD., have secured an order for two ships for the Peninsula & Oriental Steam Navigation Co., which is the largest individual order secured by the Barrow works during the last ten years. It will very considerably relieve the unemployment position, as the work on the ships will absorb an average of approximately 2,500 men for nearly two years in Barrow alone. The vessels will be propelled by turbo-electric machinery, manufactured by the British Thomson-Houston Co., Ltd., acting in collaboration with Vickers-Armstrongs Ltd. The boilers will be of the latest high-pressure type designed by Messrs. Yarrow and Co., the boilers for one ship being built by Yarrow & Co., and for the other by Vickers-Armstrongs.

The London County Council has placed orders for 10,000 tons of tram rails, valued at about £100,000, with Messrs. DORMAN, LONG & Co., LTD., and the CARGO FLEET IRON & STEEL CO.

The Consolidated Mining & Smelting Co. of Canada, Ltd., has ordered from the INTERNATIONAL ELECTROLYTIC PLANT CO., Chester, an electrolytic hydrogen plant consisting of 306 cells rated at 10,000 A. The plant will be installed in British Columbia for the production of artificial fertilisers.

Swedish Turbines for Russia.

An agreement has been signed between Karlstads Mekaniska Verkstads Aktiebolag and the Russian Commercial Delegation at Stockholm for the delivery of turbines for the new Russian hydro-electric power station on the River Svir. A message received in November said that the agreement was for three turbines of the Kaplan type, each of about 35,000 h.p. with a diameter of 7.4 metres. A fourth turbine of the same size was to be constructed according to Swedish designs at the Leningrad works of the Soviet Mechanical Trust. The value of the order, which was obtained in keen competition with German and Swiss works, was Kr. 3,700,000. The same Swedish works had previously supplied eight 11,000-h.p. turbines for the Volkhovstroy power station.—*Reuter's Trade Service* (Stockholm).

Industry and the Coal Mines Bill.

In a memorandum which has been submitted to the Government, the Federation of British Industries condemns the Coal Mines Bill now before Parliament as "wholly unacceptable to the trade and industry of the country." Objection is taken to the proposed methods of controlling output, quality and price which, it is feared, may lead to the impeding or diverting of the natural flow of coal supplies which industry requires. "Government interference with the domestic conduct of an industry is always objectionable, but this is particularly vicious when it takes the form of artificially adding to the number of sheltered industries."

The Council of the British Engineers' Association has unanimously passed the following resolution:—"The Council of the British Engineers' Association objects to the basis of the Coal Mines Bill, now under consideration, being convinced that Government intervention in the conduct of industry is against the general interests of industry, and in this particular case the Council is extremely apprehensive of its effects on the engineering industry and fears a further increase of unemployment resulting from a consequential diminution of our exports of manufactured goods."

Nottingham Contractors and Municipal Trading.

A dinner and ball in aid of the Electrical Trades Benevolent Institution was held at Nottingham on January 14th. Mr. H. Talbot presided and among the guests were the Lord Mayor (Councillor W. Wesson) and Mr. H. Marryat, chairman of the E.T.B.I.

Mr. W. J. Furse, in proposing the toast of "The Lord Mayor and Corporation" at the dinner, appealed to the Lord Mayor to use his influence against any extension of the Corporation's

trading activities. He claimed that private contractors could do electrical work more satisfactorily and at lower prices than the Electricity Department.

In replying, the Lord Mayor said that the State and local authorities continued to encroach upon private business, especially if it was remunerative.

Mr. Talbot said that they hoped to raise £50 for the E.T.B.I. from the function, and Mr. Marryat thanked the Nottingham contractors for their support. He said that an endeavour was being made to add £10,000 to the Fund this year.

Export Credit Guarantees.

During the quarter ended December 31st last the Export Credits Guarantee Department of the D.O.T. entered into contracts involving £1,308,218, bringing up the total value of contracts since July 1st, 1926, to £10,626,006. The guarantees actually given during the quarter amounted to £628,159, in respect of shipments valued at £1,003,387. Since July 1st, 1926, guarantees totalling £4,719,404 have been given in respect of shipments valued at £7,506,628. Under the earlier export credits scheme (now superseded) guarantees for £6,305,629 were given.

Steel Works to be Closed.

It has been announced that the directors of the English Steel Corporation, Ltd., which recently acquired the business of Cammell, Laird & Co., have decided to close the Cammell, Laird steel works at Penistone, Yorks. This decision has caused consternation in the town, half of whose male population is employed at the works. The company has consented to receive a deputation from the local Council on the subject.

South African Electricity Regulations.

The Senior Trade Commissioner in South Africa (Mr. N. Elmslie) has forwarded to the Department of Overseas Trade copies of the Electricity Supply Regulations for the city of Capetown and the municipality of Port Elizabeth. Copies of the regulations are available for loan to British firms, in order of application, to the Department, 35, Old Queen Street, S.W.1.

The Austrian Electrical Industry.

Dealing with the situation of the Austrian electrical industry, a Vienna correspondent states that orders from the Federal Railways have fallen off owing to the interruption in the electrification scheme, while the inauguration of individual sections which have already been equipped for electric traction is being delayed because all the locomotives have not been delivered in working order. Orders for industrial purposes are also scarce. The process of rationalisation at many works has been brought to a provisional conclusion, and various works closely connected with the Boden Credit Anstalt have been compelled to restrict their expenditure to a minimum owing to difficulties in the matter of credit. A slackening in the establishment of hydro-electric works has also taken place in Austria, and of large works in hand only the Ill works in the Vorarlberg is mentioned. Some orders for hydro-electric installations, however, have been obtained from Rumania, Jugo-Slavia and Bulgaria. Conditions will probably improve during the current year with the proposed extension of the works of the Steweag, the Zillertal works, and perhaps, further progress with the Danube power station.

Irish Free State Electrical Imports.

The imports of electrical goods, excluding machinery, into the Irish Free State during November last amounted to £55,933, bringing up the total for the first eleven months of the past year to £568,855, as compared with £483,247 in the corresponding period of 1928.

Turkish Water-power Development.

Dealing with the proposed development of trading relations between Turkey and Scandinavia, the Turkish Minister in Stockholm (Ragip Raif Bey) is reported to have stated that for this purpose a combination of interested business men is being formed in all the Scandinavian countries, including the Turkish Consuls, the reason being that the Scandinavians "are not imbued with any political considerations in the background." The exploitation of Turkey's water power is now the greatest economic question. The National Assembly has granted a sum of £T100,000,000 for this purpose, and Swedish firms are among the firms who have made investigations on the spot with a view to submitting offers. The question of awarding contracts for the work will be settled in from four to five months and the decision will probably lie between the Swedes and the French.

Local Exhibitions.

BIRMINGHAM.—There is a small but good display of electrical equipment at the Grocers', Bakers', Confectioners' and Caterers' Exhibition at Bingley Hall, Birmingham, which was opened by the Lord Mayor (Ald. Lancaster) on January 14th. The exhibits include working electric bakeries on most comprehensive lines, electrical refrigerators, fountains, &c.

DENHOLME.—An attractive exhibition of electrical appliances was arranged at the Baptist Church School, Denholme, recently, by the Electrical Distribution of Yorkshire, Ltd. The exhibition was primarily devoted to household appliances, especially electrical washing and cooking, in which daily demonstrations were given.

The Kolster Radio Co.

The New York correspondent of the *Financial Times* reported on January 14th that a shareholder of the Kolster Radio Co., United States, had petitioned for the appointment of a receiver for the company. Kolster Radio holds a controlling interest in the British company, Kolster-Brandes, Ltd.

Women Publicity Managers.

In her recent lecture to the London Technical Group of the E.P.E.A. (*vide* our last issue, p. 141) Miss C. Haslett said that only one woman (Miss Norah Miller, of the Edison Swan Electric Co., Ltd.) held any responsible position in electrical publicity. This was not quite correct; the distinction is shared by others, including Miss Dorothy Piper, advertisement manager of Holophane, Ltd.

For Sale.

Dewsbury Corporation Electricity Department has for disposal generating sets of 1,000, 500, and 300 kW, two 20,000 lb. boilers, and two 30 ft. by 8 ft. Lancashire boilers. (See our advertisement pages to-day.)

Prices of Raw Materials.

The following prices are only general, and they may vary according to quantities and other circumstances:—

	CHEMICALS, &c.	Price Jan. 21st.	Fortnight's inc. or dec.
a	Acid, Oxalic ... ... per lb.	5½d.	...
a	Ammoniac, Sal ... ... per ton	£60	...
a	Ammonia, Muriate (large crystal) ,,	£52	...
a	Bisulphide of Carbon ... ... ,,	...	...
a	Borax ... ... ,,	£25	...
a	Copper Sulphate ... ... ,,	£25 10s.	...
a	Potash, Chlorate ... ... per lb.	3d. to 4d.	...
a	,, Perchlerate ... ... ,,	5½d.	...
a	Shellac ... ... per cwt.	£13 10s.	...
a	Sulphur, Commercial ... ... ,,	£11	...
a	,, Roll ... ... ,,	£11	...
a	Soda, Chlorate ... ... per lb.	3d.	...
a	,, Crystals ... ... per ton	£5 to £5 5s.	...
a	Sodium Bichromate, casks ... per lb.	3½d.	...
	METALS, &c.		
b	Aluminium, Ingots ... ... per ton	£95 to £100	...
b	,, Wire ... ... per lb.	1/1 to 1/9	...
b	,, Sheet ... ... ,,	1/1 to 2/9	...
p	Babbitts Metal and Anti-friction Metals—		
	Grade I ... ... per ton net	£164	...
	Grade II... ... ... ,, ,,	£115	...
	Grade III ... ... ,, ,,	£65	...
c	Brass (rolled metal 2" to 12" basis) per lb.	10½d.	...
c	,, Tubes (solid drawn) ... ,,	1/0½ to 1/1	...
c	,, Wire, basis ... ... ,,	10½d.	...
c	Copper Tubes (solid drawn) ... ,,	1/3	...
g	,, Bars (best selected) ... per ton	£110	...
g	,, Sheet ... ... ,,	£110	...
g	,, Rod ... ... ,,	£110	...
d	,, (Electrolytic) Bars ... ,,	£83 15s.	...
d	,, ,, Sheets ... ,,	£143 10s.	...
d	,, ,, Wire Rods ,,	£89 15s.	...
d	,, ,, H.C. Wire per lb.	11 7/16d.	...
f	Ebonite Rod... ... ... ,,	2/3 to 2/6	...
f	,, Sheet ... ... ,,	2/3 to 2/6	...
n	German Silver Wire ... ... ,,	2/1	...
h	Gutta-percha, fine ... ... ,,	nom.	...
h	India-rubber, Para fine ... ... ,,	8½d.	½d. dec.
i	Iron, Pig (Cleveland No. 3.) ... per ton	86/-	12/6 inc.
l	,, Wire, galv. No. 8. P.O. qual. ,,	£20	...
g	Lead, English pig ... ... ,,	£23	...
g	Mercury ... ... per bot.	£23 2s. 6d. to £23 5s.	...
e	Mica (in original cases) small ... per lb.	6d. to 3/-	...
e	,, ,, medium ,,	4/- to 8/-	...
e	,, ,, large ... ,,	10/- to 20/- & up	...
p	Phosphor Bronze, plain castings ,,	1/3½	...
p	,, ,, drawn bars & rods ,,	1/5	...
p	,, ,, rolled strip & sheet ,,	1/3½	...
p	,, ,, wire... ... ... ,,	1/6	...
o	Platinum ... ... per oz.	£12 10s.	10/- dec.
d	Silicium Bronze Wire ... ... per lb.	1/3	...
r	Steel, Magnet, in bars ... ... ,,	7½d.	...
g	Tin, Block (English) ... ... per ton	£173 to £174	£4 dec.
n	,, Wire, Nos. 1 to 16 ... ... per lb.	3/5	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Reporting on the lead position on January 18th, Messrs. James Forster & Co. state that there is no fresh feature to report. Demand everywhere is exceedingly quiet, consumption moderate, while supplies are abundant, if not excessive. Prices are still under control, but it is getting increasingly evident that the intrinsic value of lead is very much lower than the present price. However, for the time being there seems little hope of a fall, although, as has been the case time and again in the metal markets in the past, prices sooner or later find a level justified by the position of supply and demand.

Italian Lamp Production.

The output of electric lamps in Italy during July last amounted to 1,921,702, bringing up the total for the first seven months of 1929 to 13,036,763, as compared with 9,038,033 in the corresponding period of the preceding year.

Radio Exhibition at Tokio.

The Department of Overseas Trade is informed by the Commercial Counsellor at Tokio that preparations are being made to hold a Radio Exhibition at Tokio from March 20th to April 18th. The Department has received from the Commercial Counsellor a limited number of copies of a preliminary circular letter and summary of the scope of the exhibition, issued by the managing director of the broadcasting station, which it is considered may be of interest to exporters of apparatus used in connection with radio transmission of sound, television, phonography, cinematography, &c. Copies of the preliminary circular letter, &c., may be obtained by United Kingdom firms on application to the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

Swiss Tariff Decisions.

The following decisions as to the classification of goods under the Swiss Customs Tariff have been issued recently by the Direction-General of Customs:—Dynamos and electric starters for motor cars, and combinations of the two—classed under Tariff No. 914 (a)—duty 110 fr. per 100 kg. gross weight. Magnetos for motor cars, and combinations thereof with other electrical apparatus (dynamo-magnetos, &c.)—classed under Tariff No. 914 (d)—duty 170 fr. per 100 kg.—*Board of Trade Journal.*

Hungarian Foreign Electrical Trade.

The *Board of Trade Journal* has published particulars of the import and export trade of Hungary for the first nine months of last year. It is shown that the imports of electrical machinery during the period had a value of 18,700,000 pengoes (£670,000 approx.) as compared with 12,900,000 pengoes (£460,000) in the corresponding period of 1928. The exports during the same period were valued at 15,900,000 pengoes (£570,000), against 13,100,000 pengoes (£470,000) in January-September, 1928.

Lighting and Power Notes.

Aberystwyth.—PROPOSED PURCHASE OF UNDERTAKING.—The Town Council has appointed a committee to ascertain terms for the purchase of the electricity undertaking. The Council has the option to purchase the undertaking in three or four years' time.

Armitage.—PUBLIC LIGHTING.—The Parish Council has decided to adopt electricity for public lighting, and to obtain energy from the Trent Valley & High Peak Electricity Co., Ltd., who will take over the lighting from February 1st.

Aylesbury.—LOANS.—The Town Council has applied for sanction to loans of £15,000 for mains and £9,000 for services for three years, and also for £2,000 to cover the cost of changing over certain sections of the borough from d.c. to a.c.

Barnsley.—MAINS EXTENSIONS.—The Corporation Electricity Committee has received sanction to the borrowing of £6,330 for mains extensions.

Bedford.—MAINS EXTENSIONS.—The Corporation Electricity Committee recommends the extension of mains at an estimated cost of £1,383.

LOAN SANCTIONED.—The Corporation Electricity Committee has obtained sanction to loans of £4,000 for mains and £5,000 for plant.

BULK SUPPLY.—The Corporation Electricity Committee reports that the main transmission line between Bedford and Luton is approaching completion, and the Central Electricity Board has required the Corporation to afford a bulk supply of electricity for transmission to Luton and Aylesbury. The supply is to be delivered to the Board at the Bedford power station at a pressure of 6,600 V, the price to be paid being (*a*) a standing charge of 2s. 1d. per month per kilowatt of maximum demand, and (*b*) a running charge equal to the actual cost of fuel per kWh transmitted from the generating station during the month covered by the account, with the addition of an increase of 10 per cent. thereto; the said increase of 10 per cent. is in no event to amount to more than 0.05d. per kWh.

LOAN.—The Committee recommends that application be made for sanction to the borrowing of £17,200 for switchgear.

Canada.—BULK SUPPLY CONTRACTS.—The Ontario Hydro-Electric Power Commission has been authorised by the Provincial Government to enter into a contract with the Beauharnois Light, Heat, & Power Company, Ltd., of Montreal, for the bulk supply during the next few years of 250,000 h.p. of electrical energy, at a cost of $15 per h.p. Delivery is to begin in 1932, and the full volume of power contracted for is to be supplied by the end of the ensuing four years. This new contract with the Beauharnois Power Corporation is the second large bulk agreement made by the Ontario Commission, the first being the contract with the Gatineau Power Company, by which 260,000 h.p. is being delivered across the Ottawa River for transmission to Toronto. The contract with the Beauharnois Company calls for the delivery of power at the Ontario boundary, and it is understood that the Hydro-Electric Power Commission proposes to erect a transmission line 40 miles long from the interprovincial boundary to the existing Gatineau-Toronto line. Towers for the duplication of this line are now being erected, and it is believed that the Beauharnois power will be brought into the Leaside distribution station by this route.

In addition to the above contract, the Beauharnois Company has also come to an agreement for the supply of 150,000 h.p. to the Montreal Light, Heat, & Power Consolidated.

HYDRO-ELECTRIC CONFERENCE.—The conference between the Federal Government and the Governments of Ontario and Quebec, on the subject of their respective rights to the water power of the St. Lawrence and other rivers, commenced last Monday. It is believed, says *The Times*, that one obstacle to its success has been removed by agreement between the engineers of the Hydro-Electric Commission of Ontario and the technical experts of the Federal Government, who originally favoured different plans for power development on the St. Lawrence, but are now understood to have reached a compromise.

Carlisle.—MAINS EXTENSIONS.—The Corporation Electricity Committee has instructed the engineer to proceed with mains extensions estimated to cost £3,276. These extensions form part of a scheme, approved by the Unemployment Grants Committee for the purposes of a grant, involving an expenditure of £13,000.

Chatham.—INSTITUTION SUPPLIES.—The Medway Board of Guardians has decided to have electricity installed at the institution and hospital. It is proposed to obtain electricity from the Kent Electric Power Co.

China.—MANCHURIA.—The South Manchuria Electricity Co. proposes to spend 2,200,000 yen on new generators at the Amanogawa power station.

Continental.—RUSSIA.—The Council of Labour and Defence (STO) has approved the electrical construction plan for the economic year 1929-30, according to which the power of the regional stations will be increased during the year by 475,000 kW. The total sum assigned to electrical construction for the year is 311,740,000 roubles (£31,174,000).—*Reuter's Trade Service* (Moscow).

FRANCE.—A new 12,000/15,000-kW turbo-generator set is to be added to each of the Aulnoye, Maubeuge, and Lomme power stations of the Société d'Electricité et Gaz du Nord.

SWITZERLAND.—The Swiss Government is reported to be considering the question of establishing a State Electricity Department to deal with the collection of statistics relative to electricity output and consumption in the country, the various applications for authority to "export" electric power, and the applications for permission to establish power transmission lines. At present much of this work is done by the Swiss State Water Power Utilisation Department, but it is felt that the electricity supply industry is now sufficiently important to require a special department to look after it.

ITALY.—A concession has recently been granted for the establishment of a 7,700-h.p. hydro-electric station to utilise the power of the River Astico, near Folgaria, Trento.

Dumfries.—MAINS EXTENSIONS.—The Town Council has decided to extend the mains at a cost of £2,550, of which £1,500 is for a Maxwelltown scheme.

East Ham.—MAINS EXTENSIONS.—The Corporation Electricity Committee is applying for sanction to the borrowing of £24,984 for mains extensions.

Edinburgh.—THE CENTRAL SCOTLAND SCHEME.—The opening of the extension of the Portobello power station and the inauguration of the grid system for Central Scotland will take place in May. Preliminary arrangements were made at a conference held recently in Edinburgh, at which Lord Provost Whitson and a sub-committee of the Corporation Electricity Committee met representatives of the Central Electricity Board.

Hull.—ELECTRICITY TARIFF REVISION.—The Corporation Electricity Committee has approved recommendations of the electrical engineer for the reduction of certain tariffs and the abolition of meter rents.

Irish Free State.—THE SHANNON SCHEME.—On January 13th Dublin was lighted for the first time by electricity generated under the Shannon scheme.

Japan.—ELECTRICITY SUPPLY.—The Nippon Denryoku K.K. has completed its 150,000-V transmission line from Ome, in the suburbs of Tokio to Tsurumi, and good progress has been made with the erection of its new 35,000-kW steam power station at Tsurumi. A 150,000-V transmission line is also being constructed from Ome to Soka. Other schemes of the company include the erection on the Kurobe River of the Kanetsuri power station, with a capacity of 65,195 kW, and the Enpi power station, with a capacity of 105,000 kW.

The Yamaguchi Prefectural Electric Bureau is preparing plans for the erection of a 45,000-kW power station, at an estimated cost of 8,000,000 yen.

The Oi-gawa Denryoku K.K. proposes to develop 60,000 kW of electrical energy on the upper part of the Oi River.

London.—BATTERSEA.—The Borough Council Electricity Committee has voted £686 for services, £320 for mains extensions and £3,110 for replacement with armoured cable of old vulcanised bitumen distributors.

HACKNEY.—The Borough Council Electricity Committee is applying for sanction to a loan of £5,000 for a free-wiring prepayment scheme.

STOKE NEWINGTON.—The Borough Council Electricity Committee recommends that application be made for sanction to loans of £8,890 for mains extensions, £9,445 for the erection and equipment of the Northern sub-station, and £2,261 for additional cables required in connection with the modification of the route of the e.h.p. cables for the Wandsworth Road sub-station.

FULHAM.—The Borough Council Electricity Committee is to apply for sanction to the borrowing of £20,000 in connection with the domestic wiring and apparatus scheme. Mains extensions are to be carried out in Molesford, Hannell, Protheroe, and Pellant Roads at an estimated cost of £930.

Middlesbrough.—CHANGE-OVER.—The Corporation has decided to circularise the authorities of the north-eastern district with respect to the proposed change-over of frequency from 40 to 50 cycles. A questionaire has been sent out asking authorities if they are in favour of the proposed change; if they are satisfied with the present frequency of 40 cycles; what advantages are expected to be obtained from the proposed change-over to 50 cycles; if compensation is expected for loss during the change-over; and what guarantee is given that the apparatus, when installed, will be satisfactory. It is stated that the change-over will cost between £5,500,000 and £8,500,000.

Midlothian.—ELECTRICITY SUPPLY.—The Calder District Committee has decided to light the streets of West Calder by electricity, and also to introduce electricity into houses in Bellsquarry, Kirknewton, West Calder, and Mid-Calder.

Newport (Mon.).—LOAN.—The Corporation Electricity Committee recommends that sanction be obtained to the borrowing of £3,975 for e.h.p. mains extensions to Whitehead Iron and Steel Co., from Caerleon sub-station to Caerleon Mental Hospital, and from Fields Park sub-station to Glasllwch, and £1,675 for kiosk sub-stations in Edwin Street and Glasllwch.

Palestine.—ELECTRICITY SUPPLY.—A concession has been granted, says *The Times*, for the supply of electricity within a radius of 14 miles of Jerusalem. According to the agreement between the Palestine Government and the Power Securities Corporation, which has acquired the rights from the Greek pre-war concessionnaire, the concession will be tenable for 44 years, and will give the company the sole right to supply electricity in the Jerusalem district, while allowing suppliers outside the Jerusalem area to erect transmission poles.

Preston.—UNEMPLOYMENT SCHEMES.—In view of a letter from the Electricity Commissioners urging the acceleration of electricity schemes to relieve unemployment, the electrical engineer has been instructed to prepare schemes for giving additional supplies of electricity in the Huncoat and Oswaldtwistle areas, and the clerk is to apply to the Unemployment Grants Committee for a grant in aid.

Price Reductions.—The following reductions in charges for electricity have been made or recommended in the following districts:—

LONDON.—*Islington.*—A reduction of ¼d. per kWh to all ordinary consumers, except power consumers, and to special consumers, where agreements provide for reductions, and a reduction from 1d. to ¾d. per kWh to all ordinary power consumers, with a further reduction of 10 per cent. as at present, to consumers taking 50,000 kWh per quarter, or 200,000 kWh per annum. Factory, industrial lighting, &c.: 2d. per kWh, with meter rent for the restricted hour use.

WHITBY.—Heating and cooking: First 100 kWh, 1½d. per kWh, remainder at 1d. Power, for consumers of under 3,000 kWh per quarter: First 500 kWh, 3d. per kWh, remainder at 2d. Power, for consumers of over 3,000 kWh per quarter: First 3,000 kWh, 2d. per kWh, remainder at 1½d. Domestic tariff: Reduction of minimum from £5 to £3 per annum.

Special Orders.—The Electricity Commissioners have submitted to the Minister of Transport for confirmation Special Orders made by them authorising the Whitby Urban District Council to supply electricity in part of the rural district of Whitby; the Ipswich Corporation to supply electricity in parts of the rural districts of Samford and Woodbridge; and the transfer to the East Devon Electricity Co., Ltd., of the undertaking authorised by the Exmouth Electricity Special Order, 1923.

Sunderland.—UNEMPLOYMENT GRANT.—The Unemployment Grants Committee has notified the Corporation of its willingness to grant 50 per cent. of the interest on approved expenditure out of a loan not exceeding £133,704, for mains and general electrical apparatus in connection with the Corporation electricity undertaking. It is proposed to raise £99,655 of the loan for 20 years, and £34,059 for seven years.

Swansea.—LOAN.—The Corporation Electricity Committee is applying for sanction to the borrowing of £25,000 for mains and services.

HOSPITAL INSTALLATION.—The Joint Committee of the Swansea and Merthyr Tydfil mental hospital has decided to electrify the whole of the institution, and to take a supply of electrical energy from the Swansea Corporation for this purpose.

United States.—HYDRO-ELECTRIC DEVELOPMENT.—According to *Power* the development of hydro-electric plants with a capacity of over 600,000 h.p. is proposed in an application filed recently by the West Virginia Power & Transmission Co., a subsidiary of the West Penn Electric Co., with the Public Service Commission of West Virginia. An extensive water-power development is planned along the Cheat River watershed in five counties in the northern and central parts of the State. The first construction planned is a storage dam, 78 ft. high, on Blackwater River. Six months after the construction of this dam the company will begin construction on the Blackwater of a dam to divert water through tunnels or conduits to a power house having a capacity of 58,000 h.p. A third project planned on the Blackwater is a diversion dam, to send water through tunnels to a second power house of 58,000 h.p. capacity.

Whitby.—ASSISTED WIRING SCHEME.—The Urban District Council has adopted a scheme for assisted wiring and the purchase and sale of fittings and appliances. The Electricity Department is to undertake the wiring through local contractors, the charge to the consumers to be the cost of the work, plus 10 per cent., and plus 5 per cent. per annum for five years. Slot meter consumers under the system are to be charged 2d. extra per kWh until the cost of the installation has been paid off.

Worthing.—ELECTRICITY SUPPLY SCHEMES.—The Town Council proposes to spend £20,000 on a ring main round the borough and £22,000 on sub-stations and equipment.

Tramway and Railway Notes.

Bradford.—TRAMWAY TRACK RECONSTRUCTION.—The Corporation Tramways Committee is to alter the tramway track at Sunbridge Road so as to provide a kerbside passenger loading station, at a cost of £918.

Continental.—SWEDEN.—The construction of an underground railway costing 40 million kroner is planned for Stockholm by Mr. Hammaren, a Swedish architect. The proposed railway will run under the central suburban districts of the city from north to south, and will have twelve stations. The capital is stated to be guaranteed by an American concern.

London.—THE CHARING CROSS BRIDGE SCHEME.—The Improvements Committee of the London County Council recommends that provisions be inserted in the London County Council (Charing Cross Bridge) Bill authorising the execution of certain works at the Waterloo, Charing Cross (Embankment) and Strand railway stations. The scheme provides for accommodation in excess of that which could be imposed on the Council as the promoter of the Charing Cross Bridge Bill, and will afford additional facilities for the general public travelling by the underground railways in question.. In collaboration with the Southern Railway Company means will be provided to enable passengers to pass by escalators between the new Southern Railway terminal station and the underground stations at Waterloo. The portion of the Charing Cross Station on the Embankment level will be moved and included within the bridge structure, and the site of the old station added to the Embankment Gardens. Booking halls will be constructed at bridge level, and escalators installed to enable passengers to pass to and from the new station below. The Strand station will be moved to the centre of the proposed traffic circus in the Strand and constructed on lines similar to the Piccadilly tube station with public subways. The removal of the Strand station will enable the Council to develop the frontages on the traffic circus to the best advantage. The aggregate expenditure on the proposed works is estimated at £652,000.

Southend.—RAILLESS CARS.—At a meeting of the ratepayers held recently to consider the promotion in Parliament of the Corporation's Transport Bill, the Corporation was authorised to spend £90,500 for railless cars and £41,675 for electrical equipment and work necessary for operating these vehicles.

The L.N.E. Railway.—TRAIN HEATING.—Electric heating has recently been applied successfully to the water used in sleeping cars on the East Coast Route night expresses. Two methods are at present in use; by the first method the water is heated at the terminal station prior to the commencement of the journey and maintained at a high temperature by the dynamo and battery installed for lighting, the capacity of the apparatus having been increased for this purpose; by the second method an additional independent dynamo and battery are fitted on the car, forming a complete self-contained water-heating system. The use of electricity for subsidiary services has been steadily developed by the L.N.E.R., says the *Railway Gazette*. The world's first all-electric restaurant car ran on its system between London (King's Cross) and Leeds in 1921, electricity being generated by dynamos connected with the wheels, and electricity is now used for cooking and lighting purposes on all the principal L.N.E.R. expresses.

Telegraph and Telephone Notes.

Automatic Telephony.—SWEDISH ACTIVITIES.—The L. M. Ericsson Telephone Co., of Stockholm, has issued a report on the number of automatic telephone exchanges and lines it has installed in different countries. It shows that Ericsson exchanges in operation or in the course of construction number 107 in sixteen different countries in practically all parts of the world. The total number of lines of the 107 exchanges is 164,290, while 237,820 are in the course of construction. The final capacity of the exchanges, when fully built out, will amount to 1,658,700 lines.

Canada.—WIRED-WIRELESS TELEPHONY.—The Bee Telephone Co. is extending its system by the construction of a new line from Oshawa (Ont.) to Sudbury (Ont.), *via*. North Bay, to be ready for operation in March. The line will be prepared for the carrier system of wired-wireless operation. The cost is estimated at approximately $1,500,000; 10,000 poles and 9,000 miles of wire will be required. The new line will provide a link to span the dominion from the Atlantic to the Pacific Oceans, placing Halifax in direct communication with Vancouver.

Chile.—NEW TELEPHONE CONCESSION.—The Chilian Senate has approved the new 50-year concession permitting the Chile Telephone Co., which is associated with the International Telephone & Telegraph Corporation, to penetrate throughout the country with its own lines and to connect the system with all other national operating systems. International service with the neighbouring Republics of Argentina and Uruguay has been established, and a definite prospect is now opened for extension to other territories served by the International system, *via* the Buenos Aires-Madrid radio link of the Compania Internacional de Radio (Chile). The new concession brings Chile within speaking distance of Europe, and shortly a similar connection will be effected with the United States. Work has already been started on a new radio-telephone station in Chile which will later provide means of direct communication between the subscribers of the Chile Telephone Co. and various countries of the world. Two years ago a subscriber in Santiago was limited to conversation with some 15,000 telephone subscribers, whereas to-day he has at his command means of communication with 265,000 subscribers in the three South American countries, and by the end of 1930 it is believed that the number will reach 28,000,000 through the extension and co-ordination of the services of the international system.

France.—LIGHTHOUSE RADIO.—The Paris Municipal Council has unanimously adopted a resolution recommending the State to provide all lighthouses with both radio transmitting and receiving sets to enable them to maintain communication with the mainland whatever may be the state of the weather. The resolution appears to have a considerable amount of support, says *World-Radio*, outside as well as inside the Council.

International Telephony.—BELGIUM.—In order to relieve the congestion on the Antwerp-Brussels and Brussels-Ghent telephone lines, a new direct cable is being laid between Antwerp and Ghent.

Italy.—VATICAN'S WIRELESS STATION.—By Royal decree the Minister of Communications has been authorised to grant the sum of 500,000 lire from the reserve fund as the Government's contribution towards the cost of installing the Vatican's wireless station.—*Reuter's Trade Service* (Milan).

Marine Radio Operators.—RATES OF PAY.—A conference recently took place between the Association of Wireless and Cable Telegraphists and the Engineering and Allied Employers' London and District Association, representing the wireless companies, to discuss an application by the union for the revision of the method of payment of British marine wireless operators. Before the 1926 award of the Industrial Court, neither the salary nor the automatic increase was affected by the tonnage of the ship to which the operator might be sent.

Peru.—TELEGRAPHY AND TELEPHONY.—There are now 11,929 miles of telegraph wires in operation, or about two miles for each 1,000 of the inhabitants. The number of telephone instruments in use in the country is 13,299, or 2.4 for each 1,000 of the population.

Photo-telegraphy.—ANGLO-GERMAN SERVICE.—The picture-telegraphy service recently established between this country and Germany has been extended by the opening of a direct service between London and Frankfurt, in addition to that between London and Berlin.

The Telephone Service.—RURAL AREAS.—The Postmaster-General states that at the end of September, 1929, some 44 per cent. of the rural post offices and railway stations in Great Britain were without public telephone call facilities, while in Northern Ireland the proportion was 69 per cent. Arrangements have, however, been made to provide such facilities in a number of localities, and further extensions are under consideration. Within the past six months 120 call offices have either been established or authorised in Northern Ireland.

United States.—TELEPHONE PROGRESS.—Whereas this year Great Britain proposes to spend about £10,500,000 on telephone development, the American Telephone & Telegraph Co. proposes to spend 700,000,000 dollars (about £140,000,000) on plant extensions, additions, and betterments in the same period. In fifty years the telephone industry in the United States has grown until it employs more than 450,000 men and women, operating physical properties representing an investment of 4 billions of dollars, which are owned by more than 500,000 stockholders.

Radio Notes.

Australia.—REORGANISATION.—A sub-committee of Cabinet Ministers has been appointed by the Federal Labour Government to consider the whole position of wireless and to make suggestions for its reorganisation.

CLASS B STATIONS.—The principal B stations (which do not receive any share of listeners' licence fees) have formed the Australian Federation of B Class Broadcasting Stations with a view mainly to resisting the policy hitherto carried out by the Postal Department, which they regard as repressive. The Postal Department has raised the licence fee of B stations from £5 a year to £25, and renewals are being granted for one year only, instead of five as originally granted; also, says *World-Radio*, the Australian Performing Rights Association is declared to be claiming excessive charges for the use of copyright music.

Austria.—RADIO INTERFERENCE.—The new draft Austrian Electricity Act contains clauses which have been drafted for the protection of radio listeners against interference caused by electrical apparatus. However, they are not considered to provide the full protection required by listeners, and so the advisory committee of the Austrian Broadcasting Company, "Ravag," has approached the Federal Ministry of Commerce and Transport and asked that in future a licence for the use of any electrical apparatus operating from the mains shall not be granted unless the proposed apparatus will not cause interference. It is also attempting to have included a clause which will make it compulsory for apparatus already in use, which is interfering with radio reception, to be fitted with protective devices.

Brazil.—AMERICAN APPARATUS.—A member of the British Chamber of Commerce of Sao Paulo and Southern Brazil expresses surprise in that Chamber's monthly journal that British wireless firms have left that market (Brazil) entirely to the Americans. Sao Paulo possesses two good wireless stations, working on wave lengths of 367 and 298 metres, with 1,000 watts and 500 watts output, respectively, and broadcasting in that and neighbouring countries is confined to the 250-500 metres wave band. As that country is now accustomed to the American type of valves, the British type with staggered pins would have no sale there, so would have to be supplied to the American pattern, as is done by Dutch manufacturers. Portable receivers are practically unknown there, so there should be a market for those goods, if manufacturers would study local requirements with regard to valves and wave lengths. There is a growing demand for all-electric sets working on a.c. at 110 volts, 60 cycles.

Brookman's Park.—ALTERNATIVE PROGRAMME TESTS.—On January 21st the published programme for London, from the end of the first news bulletin, about 6.30 p.m. until midnight, was broadcast by the "national" programme transmitter on a wavelength of 261 metres, and also by Daventry (5XX). At the same time, the regional programme transmitter, working on a wavelength of 358 metres, broadcast the published programme for Daventry (5GB). The published programme for London, therefore, was obtainable from either the "national" programme transmitter (261 m.) or from Daventry (5XX), while the published programme for Daventry (5GB) was obtainable from either 5GB, working as usual on 479 m., or the London regional transmitter working on 356 metres. A similar test will be made to-morrow.

Germany.—LICENCES.—The number of licenced listeners was 3,066,682 on January 1st, 1930, which figure represents an increase since October 1st, 1929, of 223,113, or 7.8 per cent. On January 1st, 1929, the total was 2,635,567.

Italy.—NEW STATION.—One of the largest and most powerful broadcasting stations in Europe was formerly opened on January 17th by the Minister of Communications. The station, which was designed, manufactured, and installed by the Radio Corporation of America, is situated at Santa Palomba, about 14 miles south of Rome. The antennæ power is 50 kilowatts. The wave-length is 441-8 metres and, *The Times* states, among other novelties the station is equipped with mercury vapour rectifier valves for high-voltage rectification. The antennæ are 330 ft. high, and the total cost of the installation is estimated at £150,000. The station is connected with its Rome studio by a cable.

Sweden.—CONTROL STATION.—Complaints from listeners have influenced the Government radio department to establish a new control station in the little town of Eskilstuna in Central Sweden. The cause of the complaints was disturbance by insistent and powerful interference, which was traced to a transmitting station in a capital of a central European country that had not respected the international radio convention, which it had signed, but had arbitrarily changed its wave-length.

United States.—The Federal Radio Commission has, according to *World-Radio*, compiled a revised list of stations, which shows that the number of stations licensed to operate was 594 on November 9th. The status of a further 15 has not yet been defined, as they have not been given the Commission's licence. There were 733 broadcasting stations holding the Department of Commerce's licence on February 23rd, 1927, when the Federal Radio Commission took over control. Since that date, approximately 100 stations have changed their power assignments; 20 their frequencies; 11 their frequency and power; 9 their frequency and hours of operation; 27 their hours of operation; 3 their frequency, power, and hours of operation. Sixteen new stations have been licensed and five construction permits have been issud for new stations. The new call-letter list is the first to be compiled since May, at which date 615 stations were operating. The Commission points out that the new list includes many changes in assignments of stations not shown by the net reduction of 21 stations.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Australia.—MELBOURNE.—Posts and Telegraph Department. February 18th. Jacks and number plates. (B.X. 5940.)*
March 11th. Bells and buzzers. (B.X. 6053.)*
February 25th. Jumper rings and terminal strips. (B.X. 5941.)* Switchboard plugs. (B.X. 5998.)* Magneto and c.b. telephones and automatic dials. (B.X. 5999.)* Telephone switches. (B.X. 6018.)*
March 24th. Dial parts. (B.X. 6047.)*
March 24th. Automatic exchange power boards. (B.X. 6072.)*
March 25th. Cordless switchboards. (B.X. 6071.)*
April 1st. Submarine cable. (B.X. 6070.)*
March 10th. State Electricity Commission of Victoria. Two 6,000-kVA, 3-phase transformers with spare coils and bushings. (B.X. 6014.)*
February 26th. Victorian Railways. Deaerators and accessories. (A.X. 8935.)*
February 3rd. City Council. Paper insulated cables. (B.X. 6077.)*

Basingstoke.—February 8th. Electricity Department. Supply, delivery, and erection of two heavy oil engines, each direct-coupled to one 800-kW, 3-phase, 50-cycle alternator. (January 17th.)

Belgium.—ANTWERP.—February 11th. Municipal Council. Supply and erection of two groups of mercury rectifiers for a new transformer station in the city. Particulars (Cahier des Charges) for 5 francs from Hotel de Ville, Antwerp.

Cheadle and Gatley.—February 11th. Electricity Department. Supply and delivery, as required, during the twelve months ending March 31st, 1931, of cables, lamps, meters, street lighting standards, electrical fittings, &c. (January 17th.)

Chile.—SANTIAGO.—February 19th. Chilean State Railways. Railway signalling apparatus. (A.X. 9008.)

Clutton.—January 29th. Rural District Council. Electric light installation (55 houses).—Mr. J. Wayne-Morgan, engineer, 6, Church Road, Whitchurch, Cardiff.

Cowdenbeath.—January 29th. Town Council. Electrical installation for 32 houses. Specifications, &c., from Mr. C. A. Alexander, burgh surveyor, Cowdenbeath (2 guineas deposit).

Inverness.—February 7th. District Board of Control. Rewiring of the electrical installation of the buildings of the Inverness District Asylum. Specifications from Mr. Cecil Allan Grut, Electricity Offices, Waterloo Place, Inverness.

Liverpool.—February 6th. Electric Supply Department. Approx. 252,000 tons best quality steam slack suitable for use on chain grate stokers, also 28,000 tons fine slack suitable for pulverising, for twelve months ending March 31st, 1931. Form of tender from City Electrical Engineer, 24, Hatton Garden, Liverpool.

London.—CENTRAL ELECTRICITY BOARD.—February 1st. Supply, delivery, and erection of 33,000-V overhead transmission lines for the South-East England Electricity Scheme, 1927. (January 3rd.)
BETHNAL GREEN.—January 30th. Borough Council. Electric lighting installations at a block of tenement dwellings in Bethnal Green. (See this issue.)
ISLINGTON.—February 5th. Electricity and Lighting Committee. Steel tube street lamp columns, and street lanterns. (January 17th.)
HAMMERSMITH.—February 26th. Borough Council. Stores (including electric lighting sundries, cables, joint boxes, &c.) for 12 months. (See this issue.)

New Zealand.—WELLINGTON.—Post and Telegraph Department. March 24th. Resistances and reactances. (B.X. 6046.)*
April 29th. Public Works Department. One 10,000-kVA synchronous condenser and accessories. (B.X. 6034.)* Single-phase transformers and accessories. (B.X. 6035.)* 11,000-V switchgear for Waitaki power scheme. (B.X. 6048.)*

Portsmouth.—February 10th. Tramways Committee. Supply of goods, including insulating materials, lamps, motor windings, overhead line materials, &c., from April 1st to March 31st, 1931. (January 17th.)

Salford.—February 13th. Electricity Department. Coal required during six months commencing March 1st, 1930. Particulars from City Electrical Engineer, Electricity Department, Frederick Road, Salford.
February 8th. Electricity Department.* L.p. paper-insulated, lead-covered, and armoured cable. (See this issue.)

South Africa.—LOUIS TRICHARDT.—February 18th. Municipal Council. Supply and erection of a distribution system for the town, including the supply of poles, copper conductors, transformers, meters, &c. (B.X. 6003.)
JOHANNESBURG.—February 13th. S. A. Railways and Harbours. Electric tube butt welding set. (B.X. 6005.)
February 20th. Municipal Council. Transformers. (B.X. 6043.)* Switchgear. (B.X. 6044.)*

Stoke-on-Trent.—February 12th. Electrical Engineer's Department. Electric mains van. (January 17th.) 12 months' supply of mains, cables and static transformers. (See this issue.)

Sutton Coldfield.—Electricity Department. Supply of paper-insulated, lead-sheathed, double steel tape armoured cables. (January 17th.)

Uruguay.—MONTEVIDEO.—February 15th. Posts, Telegraphs and Telephone Administration. 1,771 metric tons of telegraph wire. (A.X. 9047.)*

Wakefield.—February 1st. West Riding C.C. Electrician's work required in adaptation of premises, 95, Northgate, as offices. Form of tender, &c., from West Riding Architect, County Hall, Wakefield.

* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Australia.—SYDNEY.—New South Wales Government Railways.
1,500-V switchgear for Argyle sub-station (£5,832).—Australian General Electric Co., Ltd.
Ironclad switchgear for Ultimo (£14,577).—A. Reyrolle and Co., Ltd.
Municipal Council.
L.p. underground cables (£31,407).—British Insulated Cables, Ltd.
—*Tenders.*

Belgium.—Belgian, French, German, and British (the Bradford Ironworks, Manchester) submitted tenders on January 8th to the Belgian Post and Telegraph authorities for the supply of a large quantity of bronze wire. A German concern was the lowest for two lots of 50 tons each, while a Liége firm quoted the lowest figure for three lots of 50 tons and one of 30 tons.

Brighton.—Lighting Committee. Recommended:—
Oil-firing equipment, Southwick power station (£1,000).—Combustion Generator, Ltd.
Electric heater for raising temperature of oil (£136).—British Separators, Ltd.

Ealing.—Town Council. Accepted:—
Wiring of the Council houses on the Northolt housing estate (£370).—W. G. Hutt; and on the North and South Roads (£1,182).—Mead & Jeffery, Ltd.

Hampton.—Electricity Committee. Accepted:—
External lighting at sewage disposal works.—Twickenham and Teddington Electric Supply Co., Ltd.

Harpenden.—Urban Council. Accepted :—
Extending the cable to the sewage disposal works and supplying motors, pumps, &c. (£358).—North Metropolitan Electric Power Supply Co.

London. — ISLINGTON.—Electricity Committee. Recommended :—
Three feeder cubicles and accessories (£3,306).—Metropolitan-Vickers Electrical Co., Ltd.
FULHAM.—Establishment Committee. Recommended :—
Ceiling lights for the Council Chamber (£160).—General Electric Co., Ltd.
BERMONDSEY.—Electricity Committee. Accepted :—
Alterations and additions to main switchboard.—Crompton Parkinson, Ltd.
STOKE NEWINGTON. — Electricity Committee. Recommended :—
Seven section pillars (£372).—W. Lucy & Co., Ltd.
ST. MARYLEBONE.—Electric Supply Committee. Recommended :—
Switchgear (£44,096). Supply of bus-bar connecting chambers (£2,000).—Ferguson, Pailin, Ltd.

Swansea.—Health Committee. Accepted :—
Internal telephone system, Hill House hospital (£260).—Relay Automatic Telephone Co., Ltd.

Forthcoming Events.

Institution of Mechanical Engineers.—Friday, January 24th. Institution, Storey's Gate, S.W. 6 p.m. "General Operating Experiences with the First 'Wood' Steam Generator." Mr. E. Watson Smyth.

Junior Institution of Engineers.—Friday, January 24th. 39, Victoria Street, S.W. 7.30 p.m. "Refractories for Steam-raising Furnaces." Mr. W. J. Rees.
January 31st. "Superheating." Mr. F. Onions.

Physical Society.—Friday, January 24th. Imperial College of Science, South Kensington, S.W. 5 p.m. Ordinary meeting.

Edinburgh Electrical Society.—Friday, January 24th. Royal Arch Hall. Whist Drive and Dance.

Birmingham Electric Club.—Friday, January 24th. Grand Hotel, Birmingham. 6.30 p.m. Presidential address.

Northampton Engineering Society.—Monday, January 27th. The College, John Street. 5.30 p.m. "Realism from Records." Mr. G. A. Sowter.

Institution of Electrical Engineers. (INFORMAL MEETING).—Monday, January 27th. Institution, Savoy Place, W.C. 7 p.m. "High Tension Distribution." Mr. H. G. S. Peck.
(North-Eastern Centre).—Monday, January 27th. Armstrong College, Newcastle-on-Tyne. 7 p.m. "The Breaking Performance of High Power Switchgear and of a new form of Quenched-arc Switch." Mr. L. C. Grant.
(South-Midland Centre).—Wednesday, January 29th. Midland Institute, Birmingham. 7 p.m. Faraday Lecture, "Broadcasting by Electric Waves." Capt. P. P. Eckersley.
(West Wales (Swansea) Sub-Centre).—Friday, January 31st. Swansea. Ordinary meeting.
(North-Eastern Students' Section).—Friday, January 24th. Armstrong College, Newcastle-on-Tyne. 7.15 p.m. "Electric Traction." Lt.-Col. H. E. O'Brien. January 31st. "Electrical Propulsion of Ships." Mr. W. G. Thomson.
(North-Western Students' Section).—Tuesday, January 28th. Engineers' Club, Manchester. 7.15 p.m. Informal Discussion. "Illumination, Domestic Appliances and Industrial Heating."

Electrical Power Engineers' Association (London Local Technical Group).—Tuesday, January 28th. Junior Institution of Engineers, 39, Victoria Street, S.W. 7.15 p.m. "Regulations for the Supply of Electricity in Public Buildings, Factories, &c."
(Manchester Local Technical Group).—Wednesday, January 29th. "Changing d.c. Networks to a.c. Networks." Mr. A. W. Crompton.

Institution of Welding Engineers.—Thursday, January 30th. Chamber of Commerce, Birmingham. 7 p.m. "Modern Improvements in Electric Resistance Welding Machines." Mr. C. A. Hadley.

Diesel Engine Users' Association.—Friday, January 31st. Caxton Hall, Westminster, S.W. 3.30 p.m. "High Powered Oil Engines for Land Purposes." Mr. W. S. Burn.

Electroplaters' and Depositors' Technical Society.—Friday, January 31st. Northampton Institute, E.C. 2 p.m. Convention and Exhibition.

Nottingham Society of Engineers.—Friday, January 31st. Mechanics' Institute, North Church Street. 7.30 p.m. "The Manufacture and Installation of Colliery Cables." Mr. W. T. Anderson.

Yorkshire Electrical Engineers.—Friday, January 31st. Grand Hotel, Harrogate. Dance.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We have an inquiry for the addresses of the Fame Electric Co., and the Abba Electric Co.

Notes.

The Lighting of Hospital Operating Tables.

A lecture on this subject was delivered recently before a meeting of the Illuminating Engineering Society, held in the lecture theatre of the Home Office Industrial Museum, London, under the chairmanship of Dr. J. W. T. Walsh. The lecturer, Mr. Ernest Stroud, said that the problem called for a very high intensity of concentrated illumination, which must be practically shadowless, and have a high vertical component of intensity to ensure penetration into deep cavities. The super-intensity must be confined to the wound area, but at the same time sufficient illumination must be given around the room to prevent eye-adaptation difficulties, and yet not so much as to compete with the wound illumination; it should be produced without glare, and the light unit should be as unobtrusive as possible. To fulfil those conditions a special unit had just been developed, consisting of a number of prismatic plates formed into a panel, or false ceiling, of relatively large area. The prism construction of the plates was such as to refract the light rays which reached them into a converging beam of high intensity. Each plate was 12 in. square, and was formed of quarter-concentric prisms. They were used in groups of four, each group forming one large lens 24 in. square having a 12-in. focus. The complete unit consisted of either 15 groups of four plates, each approximately 10 ft. by 6 ft.; 18 groups, 12 ft. by 6 ft., or 21 groups, 14 ft. by 6 ft. Over each group of plates was fitted a lamp and reflector in such relation to each other that the maximum beam fell on the centre of the operating area, thus with a 15-group system the combined 15 concentrating beams coming from different directions built up and focused their rays over the predetermined area. The method employed differed from the reflector system, inasmuch as concentration from the large refracting area secured adequate diffusion, avoided harmful shadows, and absolutely avoided glare. The overflow from the lens system gave sufficient general illumination to avoid contrast glare, and the optical characteristics of the lens were such that a three-dimensional soft, or dissolving, spot was developed to take account of varying thicknesses of bodies and heights of tables. The results obtained with a 15-lens system employing 15 150-watt lamps, *i.e.*, 2,250 watts, was a maximum horizontal illumination of 1,050 ft.-candles, the illumination on a plane 45 deg. from the vertical being 725 ft.-candles, and the illumination on a vertical plane facing the centre of the tables 175 ft.-candles, without any semblance of glare. The smooth sides of the plates were fixed towards the light source, and the complete unit being totally enclosed and forming the ceiling of the operating theatre, there could be no collection of dust particles and no obstruction projecting into the theatre.

Electrical Porcelain.

The extraordinary advance which has taken place during recent years in connection with the production of porcelain insulators was emphasised at a recent lecture at Hanley before the Stoke-on-Trent Association of Engineers, by Mr. H .S. Newman, a member of the staff of Messrs. Bullers, Ltd., who pointed out that specifications had become steadily more and more rigorous, as had also the tests that were imposed. For making articles of intricate shape and comparatively small size, when the porosity specification was not too severe, the dust-pressed, or dry, process was used. The pressed cakes of clay from the filterpress were dried, ground to a fine powder in a disintegrator, damped, and the article was then formed in a steel die. Considerable progress had been made in this branch of ceramic engineering, and some very intricate dies were now in use. By means of die presses with a plain lever action, articles up to 15 in. square and 4 in. in thickness, with different shaped recesses and contours, were now being produced in a single operation. The sizes and weights of porcelain insulators were ever on the increase; for example, typical modern insulator supports installed in 132-kV grid stations had an average height of about 42 in., and the insulator was called upon to meet a torsion load of about 24,000 inch-pounds, applied clockwise and anti-clockwise; a cantilever load of anything up to 600 lb. applied at the top; and a tension up to 15,000 lb.

Insulators originally made for wireless transmission before the beam system came into use were probably amongst the heaviest pieces that had ever been produced in vitreous por-

celain in The Potteries. Each weighed when fitted about 7 cwt., and the intention was that nine of them should be fitted at the top of a pole about 800 ft. high. The specification for those insulators was: proof load cantilever, applied at the top of the insulator, 2½ tons; guaranteed u.b.s. 5 tons; snap load 30 cwt.; wet spark-over value 200 kV. An alternative used at the top of one of the G.P.O. wireless masts at Hillmorton, near Rugby, was an insulator combination which was proofed to 20 tons before dispatch. Another combination was in use at Hillmorton in which the insulators supported high-voltage meters working at 1,500 volts for the production of high-frequency current.

It was quite common nowadays for electrical engineers to call for single pieces of porcelain which stood 5½ ft. high and weighed nearly 4 cwt., and it was a common procedure to test the materials under wet conditions at flashover voltages of the order of 250,000 to 300,000 volts.

A Diesel Installation for Isolated Supply.

The principal building at Bear Wood of the Royal Merchant Seamen's Orphanage was erected for "the third" Mr. John Walker of *The Times*, and is considered to be one of the finest in the country. In 1927 the governors decided to have the engineering work overhauled and extended, and instructed Mr. E. Kilburn Scott, M.I.E.E., to proceed with a scheme he had prepared. The new plant includes a "Neckar" apparatus for treating the water; a "Beeston" boiler for central heating; a "Haslam" refrigerating plant, to take care of a month's supply of meat; and an oil-engine generating set for the electricity supply. The engine is a horizontal semi-Diesel, made by Messrs. Fielding & Platt, Ltd., capable of giving 60 h.p. at 240 r.p.m., and driving a 30-kW dynamo, 225 volts; there is also a booster for charging the storage cells. During the first year the plant ran for a total of 1,880 hours, with an average loading of 25 kW. Fourteen tons of fuel oil was used, or 0.66 lb. per kWh generated, at a cost of 0.31d. per kWh. The lubricating-oil cost was 0.084d. per kWh generated.

The only attention required is at starting and stopping, with an occasional glance at lubricators and switchboard, instruments, &c., and therefore the allocation for labour in the total cost per kWh, is very small. Including a reasonable amount for interest on capital and for depreciation of plant and building, it is estimated that the total cost is under one penny per kWh and that it will tend to come lower. Before the new installation was put down, Mr. Scott inquired into the possibilities of purchasing power from outside and of employing a gas or steam engine, but the estimated costs were much higher than the figure now being obtained. The coal and attendance necessary for the old steam-engine plant were very considerable, and the saving made possible by the new plant is expected to cover the cost within a short time. The success of this installation is another instance of the advantages of Diesel-type independent power installations for isolated electricity supplies.

Electricity in Kinemas.

The technical alterations necessitated in kinemas by the introduction of "talkie" films were described at a recent meeting of Dundee magistrates, when a statement which an inquiry by Mr. D. H. Bishop, Corporation electrical engineer, had elicited from the Scottish Office was read. The engineer had pointed out that the development of talking pictures since the 1923 regulations under the Cinematograph Act were made seemed to require a pressure of approximately 700 volts for the plates of the valves, although the current associated with that voltage was extremely small. New types of loud-speakers also required a pressure of approximately 700 volts, and the wiring between them and the microphone, gramophone "pick-up," or other source, would have to run through the auditorium. The reply from the Scottish Office specified that the high-voltage apparatus, including the transformer, should be completely enclosed in an iron cabinet, efficiently earthed, controlled by a double-pole switch near at hand, and preferably arranged so that when the door or lid of the box was opened the pressure would be automatically cut off. Any high-pressure circuits required for loud-speakers should be run in heavy-gauge screwed steel tubing. That and any other metal-work which might accidentally become charged must be efficiently earthed. It was stated that the matter had been dealt with in London on the lines indicated.

Educational.

Mr. T. J. Monaghan, M.I.E.E., chairman of the Irish Centre of the Institution of Electrical Engineers, recently had the pleasure of congratulating, and presenting the awards made to, a young Dublin student, Mr. Lorcan William Kennan, who is apprenticed to Mr. A. G. Bruty, M.I.E.E. (E.C.A.), and has obtained in the final-grade examination in electrical installation work, not only the highest place amongst apprentices to members of the Electrical Contractors Association, but actually first place in the whole examination, in open competition. Mr. Kennan thus won the silver medal offered by the City and Guilds of London Institute, the gold medal and a £20 money prize of the Electrical Contractors Association, and a scholarship valued at £25 from the City of Dublin Technical Schools, at which he received his theoretical training.

The University College (London) Committee has recently increased the annual value of the Goldsmid Engineering Entrance Scholarship from £40 to £50. The Scholarship is tenable, subject to satisfactory progress, for the three years required for a full course of study for the engineering degree or diploma, both of which may be taken concurrently. The next award will be made on the results of an examination for which candidates are required to enter not later than March 12th, 1930. The Secretary of the College will be glad to supply fuller particulars.

In connection with the prize distribution and open night of the School of Engineering and Navigation, High Street, Poplar, E.14, at which Miss Ishbel MacDonald will present the prizes, an interesting programme which has been arranged includes electrical demonstrations, exhibitions, and lectures.

The Electrical Association for Women.

"Watts" in a Home, the play to be given by the Electrical Association for Women on February 11th (8 p.m.), will be staged in the Rudolf Steiner Hall, near Baker Street Station. The play deals mainly with the development of electricity, chiefly in connection with lighting from 1800 up to the present day. Tickets, at 2s. 4d., 3s. 6d., 5s. 9d., 8s. 6d., and 10s. 6d., may be obtained from the director, E.A.W., 46, Kensington Court, W.8, or from the box office, Rudolf Steiner Hall, N.W.1.

Mr. H. Lingard addressed the Leeds branch of the Association on January 15th on the trend of lighting development in the home. He illustrated with lantern slides his advice on arranging electric lamps in a room to the best advantage, alike for lighting value and for effectiveness in appearance, and emphasised the value of having several lights in different parts of the room, instead of concentrated in the centre.

Carrera's Installation.

In connection with the article describing the electrical equipment at the new cigarette factory of Carreras, Ltd., in our last issue, we are asked to state that the signalling apparatus referred to on p. 108 was supplied by Messrs. E. Shipton and Co., Ltd.

Petrol-Electric Vehicles.

The aim of the paper on the characteristics of the above-named type of vehicles which was recently read by Mr. H. K. Whitehorn before the Institution of Automobile Engineers at Birmingham and Manchester was to remove doubts about petrol-electric propulsion and to prove that it is amenable to calculate prediction. The acceleration curve of a petrol-electric vehicle is smooth, its value changing evenly, in comparison with that of a gear-driven vehicle, which is kinked in steps corresponding to gear changes. The author investigates ideal starting conditions by elementary step-by-step calculations, to obtain which a torque-producing machine is needed which will naturally produce the calculated form of tractive effort when supplied with approximately constant power. The machine which best fulfils the requirements is the d.c. series-wound electric motor, which is employed in most electric traction systems. The author confines himself to the Tilling-Stevens system (although some 24 others have been invented), and in speaking of efficiency bears in mind that the actual overall efficiency in transmission must be calculated between the petrol tank and the road wheels; although in the case of a petrol-electric vehicle there is a comparatively much larger loss in the electrical transmission, as compared with the final transmission on top gear of a gear-driven vehicle, it is a proven fact from tests imitating city service that the petrol consumption of a modern petrol-electric vehicle will be better than that of a modern gear-driven vehicle under the same conditions. The smooth starting of the vehicle, free-wheeling, and over-drive are the main contributions towards saving petrol which offset the permanent loss, even "on top," in the dynamo and motor. It should be remembered that the efficiency of the toothed gears of a gear-driven vehicle, when operating in its lower gears, is also a comparatively low figure, and during city service a 'bus uses its lower gears for more than half of its running time; it has been shown by tests that in average city running the vehicle is on top gear for only about 20 per cent. of its running time, while in congested parts the top-gear running is less than 10 per cent. of its service time. Another important item is the comparative constancy of the efficiency of the dynamo and electric motor during the whole of their life, as contrasted with the drop in efficiency of toothed gearing of a gear-driven vehicle when the gear wheels are worn and their surfaces no longer conform to the cycloidal curves as designed. The petrol-electric vehicle is most successful for heavy loads, high engine speeds, and frequent starting and stopping, all three of which factors are more difficult with gear-driven vehicles.

High-Pressure Steam Plant in Germany.

Since 1922 no fewer than 274 boilers designed to work at pressures exceeding 420 lb. per square inch have been put into service in Germany, the number including several examples designed for working at pressures between 700 and 1,400 lb. per square inch. Electric power stations are leading the way in the adoption of high-pressure steam, there being now quite a number equipped with 560-lb. boilers. The latter are, owing to their relative high cost, usually of small size and used to meet the requirements of the base load of the power station; large medium-pressure boilers, and also steam accumulators, being employed to meet any variations in electric power supply demand. Boilers with a heating surface of from 4,300 to 6,450 sq. ft. are the most numerous; in power stations of about 50,000-kW capacity, the heating surfaces of the steam generators usually range from 7,500 to 10,700 sq. ft.; while in 100,000-kW stations boilers with a heating surface ranging from 16,000 to 21,500 sq. ft. are employed.

Appointments Vacant.

Electric cooking demonstrator and showroom assistant, for Darlington Corporation. Assistant sub-station attendant, for Stoke Newington Borough Council. Assistant electrical engineer, for Canterbury City Council. Junior charge engineer, for Portsmouth Corporation. Meter repairer, for Hastings Corporation. Assistant electrical and plant engineer, for St. Anne's Board Mill Co., Ltd. Meter testing, for the Greenock Corporation Electricity Department. Meter Department Assistant, for Cannock U.D.C. Electricity Department. (See our advertisement pages to-day.)

The O.S.A. Dinner.

It has been decided to hold the dinner of the Finsbury Technical College Old Students' Association at the Trocadero on Saturday, March 29th. All old students are asked to book the date at once, and those who are not already members of the Association should get into touch with the hon. secretary, Mr. F. R. C. Rouse, at 15, Clifton Gardens, Golders Green, N.W.11, or at Venner Time Switches, Ltd., 45, Horseferry Road, Westminster, S.W.1.

Mining Engineers' Dinner.

The annual dinner of the South Wales branch of the Association of Mining Electrical Engineers was held at Cardiff on January 18th, Mr. W. W. Hannah, branch chairman, presiding. The toast of "The Association of Mining Electrical Engineers" was submitted by Mr. W. Pugh, branch president of the National Association of Colliery Managers, who referred to the duties and responsibilities of the colliery manager. If they were left alone to work out their own destiny the future of the coal industry was nothing to be despondent about.

Responding, Capt. S. Walton Brown, national president of the Association, referred to the Coal Mines Bill and regretted to see that there was to be an alteration in the hours of work which was bound to raise the price of coal and diminish wages. There was evidence that a great deal more money than had been spent in the past would be spent in the industry in the future, and it was highly probable that electrical development would take a large proportion of it.

Proposing the toast of "The Mining Industry," the chairman, Mr. W. W. Hannah, referred to the duties of colliery managers and electrical engineers. The managers had been carrying the whole of the burden of administering collieries on their own shoulders. They were obsessed with the idea that if two men rode on a horse one must ride in front. Nowadays five people rode in the front seat of a char-a-banc, and he suggested that one feature of rationalising the coal trade was to get more than one mind to work in each particular pit. Let the colliery manager co-ordinate the work by all means, but why impose on him responsibilities for matters in which he was not an expert; why deny him the relief which could be afforded him by having a certificated electrical engineer? Mining was becoming very largely a question of using machinery, and he suggested that the mechanical and electrical engineer should be let in.

Replying to the toast, Mr. F. Ll. Jacob, member of the Conciliation Board (Owners' side), felt that the coal trade was quietly getting back to a more prosperous condition.

"Kindred Associations and Guests" were toasted by Mr. S. T. Richards, chairman, Western Sub-branch, and replied to by Mr. S. B. Haslam, chairman, Institution of Electrical Engineers (Western Centre). The toast of "The Chairman" was submitted by Major E. Ivor David, vice-president of the Association.

Institution of Electrical Engineers.

INFORMAL MEETING.—At an informal meeting on January 13th, Mr. C. F. Mounsdon was in the chair when Mr. Albert Morgan opened a discussion on "Efficiency," a subject which particularly appealed to his philosophic type of mind. He definitely repudiated all idea of associating efficiency with mass production, as his aim was not to speed-up, but to economise effort. In so many words he defined efficiency as matter in the right place and displayed an ingenious and formidable time-sheet designed, first, for putting matter in the right place by ensuring that the workman was on his job at the right moment, and a number of diagrams and graphs showed the accumulative effects of lost efficiency in the early stages of production by delay in handling a problem, awkwardness due to unfamiliarity, unsuitable tools, &c. Mr. Morgan exhibited an admirable workman's tool outfit worn as a belt. It was designed to cope with all reasonable emergencies and embodied, in addition to the usual knife, pliers, and screwdriver, a spanner, torch, voltage tester, range of adaptable carbon brushes, &c.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

Mr. R. F. DIXON, late manager of the Mansfield Tramway Co., has been presented with a gold repeating watch by the members of the Tramway Men's Social Club, of which he was the founder nine years ago and president. The presentation was made by Mr. H. Coleman, traffic superintendent.

Our Continental correspondent says that at a meeting of the Siemens and Halske Company in Berlin on January 17th it was announced that in connection with the mutual share participation with Messrs. Siemens Bros. & Co., Dr. H. WRIGHT, of the latter company, had been elected to the board of supervision of the German company. At the same time one of the directors of the German company was proposed for election to the board of the English company. The arrangements referred to were announced at a meeting in June last, which was reported in our issue of June 21st (p. 1113). The scheme gave Siemens & Halske 15 per cent. of the voting power. Foreign holdings are limited by Siemens Bros.' articles of association to 25 per cent. of the total voting power.

Mr. A. T. BULLEN, A.M.I.E.E., now mains engineer to Bedford Corporation, has been appointed to the post of electrical engineer to the Welwyn Garden City supply undertaking.

Mr. C. W. G. LITTLE, M.I.E.E., A.M.A.I.E.E., is shortly retiring from the position of chief engineer to the British Electrical Federation. Mr. Little, who was born in 1866, is an old Finsbury Technical College man. In 1889 he joined the Thomson-Houston International Electric Co., of Boston, U.S.A., and two years later was transferred to the Paris office of the French Thomson-Houston Co. In 1893 he joined the British Thomson-Houston Co., Ltd., and in the course of his six years with that company he visited India, acting also for them in connection with important electric tramway works in Dublin and plant installed by them in various parts of Great Britain. In 1889 he joined the British Electric Traction Co., Ltd., as chief executive electrical engineer and was intimately connected with numerous lighting, power, and traction undertakings here and abroad. During many years that followed he took part in important developments on behalf of that and allied concerns in New Zealand, Bombay, Argentina, Brazil, Russia, and Finland. His more recent work has been connected with the Stourport power station of the Shropshire, Worcestershire and Staffordshire Electric Power Co. and with the electrification of the Swansea and Mumbles Railway.

Mr. THOS. ROLES, city electrical engineer, Bradford, and Mr. C. E. ALLSOPP, manager of the Corporation's electrical showrooms, were last week elected vice-presidents of the Bradford Publicity Club. Mr. Allsopp, in particular, has been actively associated with the club from its inception.

The Finance Committee of the Inverness Town Council recommends that the salary of the electrical engineer and manager be increased from £600 to £650 per annum, and that of his chief assistant from £275 to £300 per annum.

The Electricity Committee of the Epsom Urban District Council recently considered an application from the electrical engineer, Lt.-Col. H. W. WATTS, for an increase in his salary to £750 to place it on the scale laid down by the Associated Municipal Electrical Engineers. While the Committee was not prepared to agree to this, it considered that recognition should be made of Lt.-Col. Watts's work in developing the undertaking, and it recommended the Council to raise his salary from £600 to £700.

In addition to his portrait in oils presented by the staff of his department, Mr. R. A. CHATTOCK has received further gifts upon his retirement from the position of city electrical engineer, Birmingham. The chief officials of all departments of the Corporation have given him a handsome service of Georgian glassware. Mr. Jennings presided at a luncheon and made the presentation on behalf of the city's officials. The members of the Electric Supply Committee have also entertained Mr. Chattock at dinner, Councillor Beale presiding, and presenting him with a silver fruit dish, subscribed for by the members of the Committee, together with an illuminated minute of appreciation of Mr. Chattock's services during the past 26 years.

Hammersmith Borough Council Electricity Committee reports that Mr. J. F. SARVENT, station superintendent, has resigned his position having obtained an improved appointment with the Leeds Corporation. The borough electrical engineer recommends that the position of station superintendent should not be filled as such, but that two new positions should be created to be known as "Electrical Superintendent" and

"Mechanical Superintendent," respectively, and that Mr. A. T. GORDON-SMITH (senior engineer-in-charge) be promoted to the position of electrical superintendent at a salary of £467 per annum; that Mr. G. A. TROTMAN (repairs engineer) be promoted to the position of mechanical superintendent at a salary of £467 per annum; and that Mr. A. C. TEDSTONE (engineer-in-charge) be promoted to the position of senior engineer-in-charge at a salary of £394 per annum.

Mr. GILBERT GLEDHILL, a director of Messrs. G. H. Gledhill and Sons, Ltd., of Halifax, and of Gledhill-Brook Time Recorders, Ltd., of Huddersfield, has been adopted by the Halifax Conservative Association as its prospective Parliamentary candidate.

The long-standing association between seafarers and the wireless service was acknowledged at the Candlemas Court of the Worshipful Company of Shipwrights when Mr. F. S. HAYBURN, deputy managing director of the Marconi International Marine Communication Co., Ltd., was admitted a freeman and liveryman of the Company, whose foundation dates back to 1260.

Obituary.—MR. T. BARTON.—We regret to learn that Mr. Thomas Barton, of Colinfield Farm, Wigan, died on Thursday last week from the effects of gas poisoning. Mr. Barton had been in ill-health and had to relinquish his work on that account. He obtained the B.Sc. degree of Manchester University, and had held important positions in the research departments of works in Manchester, London, and Wigan. Latterly he had suffered from sleepy sickness.

MR. B. SANKEY.—We regret to report that Mr. Bernard Sankey, general manager of the Johannesburg Municipal Electricity Department, died on January 12th, at the age of 52. Mr. Sankey had already tendered his resignation on account of ill-health, and in accepting it the Johannesburg City Council had decided to give him a testimonial under its seal. His engagement was to terminate on January 31st. Mr. Sankey was trained at Faraday House. When acting as municipal electrical engineer at Whitehaven he was recommended by the late Mr. Robert Hammond and Messrs. Davis & Soper, Ltd., about 17 years ago, to the Port Elizabeth Municipality for the position of chief electrical engineer, and he was appointed. Ten years ago he became chief engineer to the Johannesburg Municipal Electrical Department. Under his management the plant at Johannesburg was increased until the peak load became 24,000 kW. Mr. Sankey was a past-president of the South African Institute of Electrical Engineers. The funeral was largely attended, the Mayor and Councillors of Johannesburg and nearly all the electrical staff being present. The Port Elizabeth Council and its electrical staff were also represented.

Will.—The late Mr. SAMUEL WHITE, chairman of the Bristol Tramways and Carriage Co., Ltd., and the Imperial Tramways, Ltd., left estate valued at £297,490 (net personalty £267,352).

Financial Section.

New Companies, Returns of Share Capital, Debenture Charges, Reports of Electrical Companies Dividend Charges, Transactions in Stocks and Shares.

New Companies Registered.

Gordon Products, Ltd.—Private company. Registered January 13th. Capital, £500 in £1 shares. Objects:—To carry on the business of radio manufacturers and dealers, formerly carried on as the "Gordon Laboratories," at 492, Wandsworth Road, S.W. The directors are: C. L. Elliott (permanent managing director), 10, Queen's Road, Batterses, S.W.8; D. A. Bain, 15, Dragon Road, Peckham, S.E.15; W. N. James, 14, Taybridge Road, Clapham, S.W.11. Qualification: £1. Secretary: C. E. Cooper. Registered office: 54, Chancery Lane, W.C.2.

Scientific Appliances, Ltd.—Private company. Registered January 15th. Capital, £500 in £1 shares. Objects: To carry on the business of electrical and mechanical engineers, scientific appliance manufacturers, opticians, metal merchants, radio engineers, &c. The subscribers (each with one share) are: K. B. Dunn, 2, Catherine Villas, Wellington Road, Belvedere, Kent, solicitor's clerk; L. Parkin, 26, Cherry Tree Road, N.2, solicitor's clerk. The first directors are to be appointed by the subscribers. Solicitor: W. H. Lane, 27, Chancery Lane, W.C.2.

Standard Radio Co., Ltd.—Private company. Registered January 14th. Capital, £400 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in electrical apparatus, wireless, broadcasting and television instruments and apparatus, &c. The permanent directors are: P. H. Sheath (managing director), Beachy House, Firtree Road, Banstead, Surrey; M. A. Mason (chairman), 30, Station Road, Belmont, Surrey. Solicitors: Harrington Edwards & Cobban, 33, Southampton Street, Strand, W.C.2.

Official Returns of Electrical Companies.

F. W. Potter & Soar, Ltd.—Three land registration charges dated August 31st, 1928, charged on various properties in Shoreditch, &c. (properties acquired September 1st, 1929) on which £12,000 was owing on November 1st, 1929. (Now registered pursuant to Section 91 of the Companies Act, 1929.) Holders: Westminster Bank, Ltd.

Ferolite, Ltd.—Issue on January 8th, 1930, of £3,300 debentures, part of a series already registered.

Robins, Ltd.—Satisfaction (1) in full on January 3rd, 1930, of debenture dated April 3rd, and registered April 7th, 1925, securing £550, and (2) to the extent of £1,100 (being amount issued) on same date of debentures authorised by resolutions of June 15th, and July 8th, and registered July 17th, 1926, securing £2,000.

Particulars filed of £4,250 debentures authorised January 3rd, 1930, charged on the company's undertakings and property, present and future, including uncalled capital (if any), the whole amount being now issued.

Builth Wells Electric Supply Co., Ltd.—Satisfaction in full on December 31st, 1929, of debentures authorised September 4th, 1925, and registered April 10th, 1926, securing £2,500.

Rangoon Electric Tramway & Supply Co., Ltd.—Satisfaction to the extent of £11,520 on April 24th, and to the extent of £6 on October 16th, 1929, of debentures dated February 1st, 1906, to January 25th, 1924, securing £250,000. (Notice filed January 2nd, 1930.)

Ericsson Telephones, Ltd.—Satisfaction to the extent of £50,000 on December 31st, 1929, of debentures authorised April 4th, and registered April 11th, 1912.

Ashton Electrical Co. (Preston), Ltd.—Satisfaction to the extent of £200 on January 6th, 1930, of mortgage dated October 1st and registered October 6th, 1927.

C. A. Vandervell & Co., Ltd.—Satisfaction in full on December 20th, 1929, of a second debenture dated December 31st, 1920, and registered January 18th, 1921, securing £200,000.

Ozonair, Ltd.—Satisfaction to the extent of £8,000 on December 31st, 1929, of debentures authorised June 12th and registered November 20th, 1922.

City Notes.

Ever-Ready Trust and Finance Co., Ltd.

This company's report was reviewed in our last issue (p. 129). Presiding at the first annual meeting, on January 17th, Mr. Magnus Goodfellow (chairman) said that they had started operations in a period of great difficulty, but they had done as well as most concerns, and better than many. The company held 500,000 preference shares in Lissen, Ltd. It had been the intention of the latter company to make a public flotation, but the market conditions precluded this. The investment was considered worth more now than when it was first made. The 128,845 shares in the Ever-Ready Co. (Great Britain), Ltd., showed a depreciation, but he was satisfied that that could be regarded as merely temporary. Their only investment in the "Hatry" group was £5,000. The board thought it better to build up a strong financial position instead of paying an immediate dividend. He was hopeful regarding the future. The report was adopted after considerable discussion.

J. & E. Hall, Ltd.

The report for the fourteen months ended September 30th shows a net disposable balance, after including £7,397 brought forward, of £67,776. After allowing for the preference dividend, it is proposed to pay a final dividend on the ordinary shares of 5 per cent., making 8½ per cent.; leaving a balance of £9,676 to be carried forward.

Imperial and International Communications, Ltd.

This merger company announces that for the purpose of acquiring the whole or part of the undertakings of the undermentioned companies, and for providing for the purchase price of the Pacific Cable Board's Pacific Cable undertaking and West Indian telegraph system, and of the Imperial Atlantic Cables, the share capital of the company has been increased from £100 to £30,000,000, divided into ordinary shares of £1 each. These shares have been allotted as follows:—

	In respect of the transfer of communications assets.	At par in respect of cash provided for the purchase of Government undertakings.	Total
Eastern Telegraph Co., Ltd.	10,626,608	552,947	11,179,555
Eastern Extension, Australasia & China Telegraph Co., Ltd.	6,533,050	287,957	6,821,007
Western Telegraph Co., Ltd.	4,724,845	239,333	4,964,178
Marconi's Wireless Telegraph Co., Ltd.	4,225,517	186,249	4,411,766
African Direct Telegraph Co., Ltd.	330,397	—	330,397
Europe & Azores Telegraph Co., Ltd.	132,689	—	132,689
Eastern & South African Telegraph Co., Ltd. ...	1,414,439	—	1,414,439
West African Telegraph Co., Ltd.	206,105	—	206,105
London - Platino - Brazilian Telegraph Co., Ltd. ...	193,481	—	193,481
Pacific & European Telegraph Co.	89,587	—	89,587
River Plate Telegraph Co., Ltd.	31,928	—	31,928
West Coast of America Telegraph Co., Ltd. ...	224,868	—	224,868
Totals	28,733,514	1,266,486	30,000,000

Adelaide Electric Supply Co., Ltd.

The gross revenue for the year ended August 31st last was £839,156, as against £801,514, and the net revenue £450,724, as compared with £411,946. After writing off new issue expenses and debenture service, £90,000 is allocated to reserve and £15,000 to the contingencies fund. The dividend of 12 per cent. on the ordinary shares is maintained and £32,000 is carried forward. The number of consumers increased during the year from 79,640 to 82,495, and the total connections from 133,033 to 148,369. The electrical energy sold totalled 65,407,816 kWh, as compared with 61,903,929 kWh in 1928.

Calcutta Electric Supply Corporation, Ltd.

In our last issue (p. 128) we published a report of the meeting held on January 10th to consider resolutions securing the maintenance of British control in this company, and stated that although the resolutions were carried by a show of hands a poll was demanded. The result of this poll, announced last week, was as follows:—For the resolutions, 1,061,438 votes; against, 77,071. The necessary three-fourths majority was thus obtained.

Stock Exchange Notices.

Dealings in the following have been allowed by the Committee under Rule 159:—

Telephone Manufacturing Co. (1929), Ltd.—1,000,000 ordinary shares of 5s. each, fully paid, Nos. 1 to 1,000,000.

Telephone Rentals, Ltd.—2,400,000 ordinary shares of 5s. each, fully paid, Nos. 1 to 2,400,000.

The undermentioned have been ordered to be officially quoted:—

American Telephone and Telegraph Company.—$3,008,700 capital stock.

Official Notice *re* Companies.

The names of the undermentioned companies will be struck off the Register at the expiration of three months, unless cause is shown to the contrary:—

Fairfield-Howden, Ltd.
Regent Electrical Co., Ltd.
Ruths Steam Accumulators, Ltd.

Aluminium Corporation, Ltd.

Meetings of stock and share holders have been called for February 14th to consider proposals for the reorganisation of the company's capital, details of which will be given in our next issue.

Delhi Electric Supply and Traction Co., Ltd.

An interim dividend of 4 per cent., less tax, has been declared.

Atlas Electric and General Trust, Ltd.

An interim dividend of 2 per cent., less tax, has been declared on the ordinary shares.

German Company.

The directors of the *Allgemeine Elektricitäts Gesellschaft* have declared a dividend of 9 per cent. out of profits of 19,170,000 marks for last year.

Stocks and Shares.

TUESDAY EVENING.

STOCK Exchange and City hopes that money might become cheaper towards the end of the first month of this year look as though they will be doomed to disappointment. The efforts of the tax-gatherer are making their influence felt upon floating supplies of capital, and people are already beginning to talk about the Budget as a possible nigger in the hedge. Nevertheless, the position in Lombard Street fluctuates from day to day to an extent which renders it at least conceivable that money will become plentiful again, and in the near future. The North-West Midlands Joint Electricity Authority 5 per cent. issue, which met with so cold a reception on the part of the public that the underwriters had to take up about 85 per cent. of the whole amount, is being absorbed, and the quotation is now about 1 discount on the issue price of 98½. The first interest payment, it may be recalled, is due on July 1st this year, and is for the broken amount of £1 15s. per cent. No considerable amount of stock of this description is on offer in the markets, and, as already observed, if the North-West Midland fives had been given the prestige of a trustee security, the issue would probably have been all taken by the public.

Trustee Stocks Available.

There is very little indeed of the Trade Facilities Acts securities available for the investor, the market in such stocks as Central London, City & South London, London Electric 4½ per cent. second debentures, 1942-1972, being almost bare of supply. Trustees are allowed to invest in London Electric 4 per cent debenture, of which there is £5,000 on offer at 77½, giving a return of £5 3s. 6d. per cent., and the same company's 4 per cent. preference stock is also eligible for trusts, the yield at the present price of 72½ being £5 12s. per cent. Modest amounts can be obtained of the 4 per cent. debenture stocks of the Central London Railway, City & South London, and Metropolitan District, which, at their present prices, give an average return of £5 3s. per cent. on the money.

Tube Railways' Strength.

One of the features in our price lists this week is the jump of 4 points in Underground Electric income bonds, which is the more remarkable in that it follows an advance of an equal amount a week ago. At the beginning of the year, the price of the stock stood at ¼ point or so over par, and the shares were down to the neighbourhood of a guinea. The latter have risen now to 23s. 6d. Instead of the market being depressed by the idea that the Government's intervention in London traffic will be a bear point for proprietors of the Underground Electric Railways, the opinion has swung round in the other direction. Talk now runs upon the possibility that this Government co-operation may turn out to be a good thing after all. The dividend on the shares for 1928 was 7 per cent., and the optimists talk cheerfully of the likelihood that this will be raised to 8 per cent. in respect of the twelve months just ended. The announcement comes on February 13th, and the stocks of the group as a whole are in active request. Districts have risen 1½ to 72, and Metropolitan at 66½ is 3½ points higher, for which latter rise there is, of course, the expectation, frequently reflected here, that the company will pay at least 4 per cent. for the year just ended, against 3½ per cent. in the previous period. The Home Railway market is, generally speaking, more cheerful than it has been for some time past.

Under the London County Council Charing Cross Bridge Bill, the underground stations at Waterloo, Charing Cross and the Strand will have to be reconstructed. It is said that the companies will carry out the work at these three stations at their own expense, but that the L.C.C. will pay £225,000 towards the cost as the operations proceed.

Home Electricity Supply.

Home Electricity Supply shares are better, where the prices have moved at all. Metropolitans have advanced to 37s. 6d., County of London ordinary continue their rise, and are now 46s. 3d., the preference also being a little harder. In the Provincial list, quiet buying of Bournemouth & Poole sufficed to raise the price by 3s. 9d., the quotation being advanced to 3 1/16. Scottish Power are 1/- up, at 30s. Lancashire Electrics are better at 27s. 6d., and the 7 per cent. participating preference firmed up, in sympathy, to the same price.

Outside these, Victoria Falls strengthened to 3 1/16. This is due to the renewed attention paid to the possibility of the company being considerably benefited by the present-day activities in the Northern Rhodesia copper fields. Although the yield on the money at the present rate of dividend must be regarded as modest, there is a strong possibility of its being advanced, and, as Kaffir mining shares happen to have come into a little favour of late, this gave an added impetus to the inquiry for Victoria Falls shares. Egham and Staines have gone back a trifle to 31s. 3d. Northamptons at 44s. 6d. have gained the pence. Richmond Electrics remain at two guineas, Isle of Thanet ordinary at 31s. The new Metropolitans are steady at 36s. 6d., and County of London new shares retain their advance at 7s. premium. British Light & Power are a dull market, losing a shilling at 13s.

Allotments to Cable Companies and Marconi's.

The International Communications Company, which is the operating unit of the Cables and Wireless Company, has now

published particulars of the allotments of the shares made to the cable companies concerned, and to Marconi's. The chief interest centres upon the amount that is allotted to Marconi's. Whereas most of the stock and shares in the cable companies are now comfortably settled into the combine, a proportion of the Marconi £1 shares has remained outside the merger, and is in the hands of holders who, all along, have contended that the terms awarded to them should be revised. According to the figures now announced, it would seem that no special provision has been made for these Marconi £1 shares. They will be brought into the merger on the same footing as the Marconi 10s. shares, due allowance being made, of course, for the extra 10s. per share paid on them. This is pretty certain to arouse protest, because the holders of Marconi £1 shares, if a small body, have been, at any rate, clamant, not to say militant, in their disagreement with the manner in which they have been treated in the merger.

Cables and Communications.

Cables and Wireless stocks are inclined to be dull, the 5½ per cent. preference easing off to 98½, while the other two stocks show a heavy tendency. Anglo-American Telegraph preferred is better at 103. Anglo-Portuguese Telephones are a guinea. American Telephone and Telegraph capital stock is unchanged at 224, International Telephone and Telegraph at 71 being 4 points lower on the week. A fair amount of activity has been noticeable in Radio Corporations, about 35½. Those in charge of the Western Union Telegraph Company have been explaining away their reported reference to having obtained control of traffic to such an extent that the American communication services hold the British monopoly "in the hollow of their hand." This appears to have been something of a picturesque exaggeration, and, while it aroused a little nervousness amongst some of the more timorous proprietors in Cables and Wireless, the statement was received with amusement by other people who know the strength of the British combine.

Melbourne Electric Supply.

The Melbourne Electric Supply Company, in its report for the year to the end of last August, declares a dividend of 10 per cent. free of tax on the ordinary stock, and adds that the Government of Victoria has given notice of its intention to purchase the undertakings of the company on September 1st this year. In consequence, the directors are now giving very careful consideration to the position that will arise on that date. Melbourne Electric Supply ordinary stock is quoted at 170 in the Stock Exchange list, business being marked at that price on January 13th. It is anticipated that the transfer value of the company will be in the neighbourhood of 38s. per share, equivalent, that is to say, to 190 per cent., and this latter price is expected to be, roughly speaking, about the amount that stockholders should receive towards the end of the current year. The company has paid its proprietors very well, and a good many of them will regret the transfer, though it has been known all along that this would be effected.

Indian Shares.

Australian stocks and shares are still inclined to droop, nor has there been any noticeable change in the dulness which Indian issues have suffered in consequence of the disturbance caused in the minds of investors by the recent political developments, and the consequent shrinkage in the values of India Government stocks. Calcutta Electrics are a little easier at 47s., and Calcutta Tramways have been changing hands at 13s. 7½d. Delhi Electric Supply and Traction ordinary have gone back to 36s. 3d. Madras Electric ordinary are 27s. 6d. In the foreign group, Lisbon Electric Trams have gone back to 23s. Atlas ordinary keep about 27s. 6d., and the preference are 24s.

Dollar Stocks.

Brazilian Tractions remain a popular speculation, and on balance the shares have dropped a point to 39, the preference being 130. Montreal Light, Heat and Power shares at 138½ are 4 points up; Pennsylvania Water remain at 77½, Power Corporation of Canada, at the same price, being a point to the good. Shawinigans at 81 have lost part of their last week's rise. Canadian General Electrics continue to be officially quoted at what seems to be the needlessly wide figure of 250 to 300. Hydro-Electrics rose from 42 to 44, but failed to hold the full extent of the improvement, going back to 42½. Mexico Tramway shares are lower at 28¼. The company's 5 per cent. bonds have shed 4 points to 82½, and the sixes fell to 49½. The Mexican Light and Power group is unchanged. Puebla Tramways have gone back to 21, the recent American support being withdrawn, for the moment.

Miscellaneous Matters.

Shares in the manufacturing companies continue to show a rising tendency. Telegraph Constructions are 10s. up at 24½. Henleys rose to 6 1/16, Callenders to 3 11/16, British Insulated to 3 15/16. The last-named touched 4 1/16, a price that tempted sellers. Associated Electric ordinary are firmer at 28s., but no change of consequence has occurred in G.E.C. shares. The iron and steel group has discovered nothing of fresh interest. Vickers came on offer at 8s. 9d. Rubber shares looked like improving, but they could not stand against a further decline in the price of the raw material, and the incipient strength soon evaporated. Ever-Ready and Ever-Ready Trust shares have been dullish. The London Nigerian Power Company, formed to generate and distribute electrical power in Nigeria, has been registered, with a capital of £100,000 in five-shilling shares.

Share List of Electrical Companies.

	Nom.	Approx. Dividend. 1927.	1928.	Price Jan. 21 1929.	Rise or fall	Yield p.c.
HOME ELECTRICITY COMPANIES.						
Bournemouth and Poole	£1	15	15	3⅞	—	4 18 0
Brompton Ordinary	£1	8½	8½	25/6	—	5 9 10
Charing Cross Ordinary	£1	8½	8½	26/-	—	5 7 8
do. do. 4½% Pref.	£1	4½	4½	17/-	—	5 6 0
Chelsea	£1	8¾	8¾	25/-	—	5 12 0
City of London	£1	10	10	22/-	—	4 7 6
do. do. 6% Pref.	£1	6	6	22/6	—	5 6 8
Clyde Valley	£1	8	8	36/3	+6d.	4 8 3
County of London	£1	7	10	46/3	+1⅛	4 6 8
do. do. 6% Pref.	£1	6	6	22/6	+6d.	5 6 8
Edmundson's 7% Pref.	£1	7	7	24/-	—	5 16 8
Elec. Supply Corporation	£1	11	11	47/-	—	4 18 7
Kensington Ordinary	£1	8	8	26/-	—	5 7 8
Lancs. Light and Power	£1	7½	7½	27/6	+6d.	5 9 1
London Electric	£1	8½	9	26/6	—	5 5 8
Metropolitan	£1	9	9	27/6	+1⅛	4 16 0
do. 4½% Pref.	£1	4½	4½	17/-	—	5 6 0
Midland Counties	£1	6½	6½	28/-	—	4 12 10
Mid. Elec. Power	£1	15	8	33/9	—	4 14 10
Newcastle-on-Tyne Ordinary	£1	6	6	23/9	—	5 1 1
do. 7% Pref.	£1	7	7	25/6	—	5 9 10
Notting Hill 6% Pref.	10	6	6	1/2	—	5 11 4
North Met. Elec. 6% Pref.	£1	6	6	22/-	—	5 9 1
St. James' and Pall Mall	£1	8	8	25/-	—	5 12 0
Scottish Power	£1	8	8	30/-	+1/-	5 6 8
South London	£1	8½	8½	25/6	—	5 9 10
Urban Ordinary	£1	7	7	33/9	—	4 3 0
Westminster Ordinary	£1	8½	8½	25/-	+	5 12 0
Whitehall Elec. Invst. 7½% Pref.	£1	7½	7½	23/6	—	6 7 8
Yorkshire Elec.		8		32/6	—	4 18 6
HOME RAILS.						
Central London Ord. Assented	Stock	4	4	71	—	5 12 8
Metropolitan	£	8	8½	66½	+2½	5 5 3
do. District	£	4	5	74	+1½	6 15 2
Underground Electric	£1	5	7	23/6	+1/6	5 19 2
do. do. Income	Bonds	6	6	110	+4	5 9 1
TELEGRAPHS AND TELEPHONES.						
Anglo-Am. Tel. Pref.	Stock	6	6	103	+½	5 16 6
do. Def.	,,	1½	1½	24½	—	6 4 5
Automatic Telephone	£1	10	12½	37/6	—	6 13 4
Cables & Wireless 5½ Pref.	Stock	—	—	98½	—½	5 11 8
do. A 7½ Ord.	,,	—	—	76½	+1	... ...
do. B Ord.	,,	—	—	87½	—	... ...
Globe Tel. and T. Ord.	£1	10	10	23	—	*4 7 0
do. do. Pref.	£1	6	6	11	—	5 9 1
Great Northern Tel.	£1	20	20	31	+½	6 9 0
Indo-European	£1	10	10	52½	—	*3 16 2
Marconi-Marine	£1	12½	15	23	—	... ...
Oriental Telephone Ord	£1	12	12	21½	—	*4 5 5
HOME AND FOREIGN TRAMS, &c.						
Anglo-Arg. Trams First Pref.	£	5½	5½	3⅛	—	8 19 6
do. do. 2nd Pref.	£	6	6	3	—	10 0 0
do. do. 5% Deb.	Stock	5	5	72½	+1	6 18 10
British Electric Traction Def. Ord.	,,	5	5	1575	+50	... ...
do. do. Pref. Ord.	,,	8	8	121½	—	6 11 9
Brazil Traction	100	7	8	39	—1	5 2 6
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	88½	+1	5 13 0
London & Sub. Trac. 5% Pref.	1	Nil	Nil	10/6	—	... ...
London United Tram Deb.	Stock	4	4	50½	—	7 18 0
Mexico Trams, 5% Bonds	—	5	5	62½	—4	8 0 0
Mexican Light Common	100	Nil	Nil	6⅝	—	... ...
do. 7% Pref.	100	7	7	72½	—	9 13 2
do. 1st Bonds	—	5	5	74½	—	6 14 8
Victoria Falls Ord.	£1	15	15	3⅞	+1/6	4 18 0
Yorkshire (West Riding)		Nil	Nil	5/-	—	... ...
MANUFACTURING COMPANIES.						
Assoc. Elec. Ord.	£1	6	—	2⅞/-	+6d.	4 5 9
Babcock & Wilcox	£1	13	15	3	—	*5 0 0
British Aluminium Ord.	£1	10	10	46/-	—	*4 7 0
British Elec. Transformer Pref.	£1	7	7	10/-	—	... ...
British Insulated Ord.	£1	15	15	3¹⅞	+1/6	8 16 2
Brush Ord.	Stock	10	10	126½	—	7 18 1
Callenders	£1	15	15	3¹⅞	+1/6	4 1 1
do. 6½% Pref.	£1	6½	6½	1¾	—	5 4 0
Crompton Parkinson Ord.	£/-	—	80	20/9	—	7 4 3
do. 8% Pref.	£1	8	8	25/-	—	6 8 0
Edison-Swan 1st Pref.	£1	7½	7½	24/6	—	7 1 2
do. 5% Deb.	Stock	5	5	94½	—	5 18 4
Electric Construction	£1	7½	5½	15/-	—	7 6 8
Enfield Cable Ord.	£1	20	20	4¾	—	4 2 0
English Electric	£1	Nil	Nil	5/-	—	... ...
do. do. Pref.	£1	3	Nil	7/6	—	... ...
Gen. Elec. Pref.	£1	6½	6½	24/-	—	5 8 4
do. Ord.	£1	10	10	2¹⅞	—	4 6 7
Henley	£1	25	30	6¹⅛	—	4 18 8
do. 4½% Pref.	£1	4½	4½	4¾	—	5 6 0
India-Rubber	£1	Nil	Nil	11/3	—	... ...
Johnson & Phillips	£1	10	—	26/3	—	5 10 3
Siemens Ord.	£1	7½	7½	25/-	—	6 0 0
Telegraph Construction	£5	10	10	24½	+½	*4 17 7

*Dividends paid free of Income Tax.

Our Overseas Electrical Trade.

A Review of Exports and Imports during 1929.

WITH the publication of the Board of Trade returns for December, we are able to make a review of our overseas electrical trade during the past year.

The exports during December (see Table I), although substantially below those of the preceding month, were above the monthly average for the year. The decline as compared with November was fairly general, but an outstanding exception was the telegraph and telephone material section, the three items of which showed a total rise of £117,973. The only other increase occurred in the case of "other" motors and generators (£22,893), but in spite of this the machinery section as a whole registered a fall of £26,198. The greatest decline was shown against insulated wires and cables, but in November exports of this class reached a high figure. The only other decreases of any magnitude were recorded for unenumerated goods and apparatus, and batteries and accumulators. As compared with December, 1928, there was a substantial increase in electrical exports. This improvement was general and four items—unenumerated goods and apparatus, insulated wires and cables, "other" motors and generators, and telegraph and telephone apparatus—showed rises of over £50,000. The telegraph and telephone section as a whole recorded an increase of £129,610. The net increase in the machinery section was £25,143. Only two decreases were of any magnitude, those in unenumerated electrical machinery (£30,956) and batteries and accumulators (£11,859).

Imports were maintained at a very high level, the total being the second largest ever recorded. (The highest point, £1,007,423, was reached in October last.) As compared with November there was a small increase. Rises in imports of meters and instruments (£89,265), machinery (£30,265), and glow lamps (£26,048), were largely offset by decreases in telegraph and telephone apparatus (£57,742), batteries and accumulators (£56,075), and unenumerated goods and apparatus (£18,706). The import total was greatly in excess of that for the corresponding month of 1928—£293,678, owing, mainly, to larger purchases of meters and instruments (increase £118,332), glow lamps (£64,103), unenumerated goods (£55,223) and unenumerated machinery (£41,082). The most notable decrease is the one which imparts the reminder that in 1928 submarine cable valued at £5,950 was imported; this is an unusual item.

The re-export section does not exhibit much of interest; the principal difference as compared with November was a decline of £7,668 in the case of telegraph and telephone apparatus.

Table II gives an analysis of British exports of electrical machinery during December and for the whole of the past year, and the figures are compared with those for the corresponding periods. In December there was a small increase over the December, 1928, total. We again sent more to European countries, while the shares of Japan, South Africa and Australia also rose in value. Turning to the figures for the year, it will be seen that India remained our most im-

Table I.—Exports and Imports during December 1929.

	Exports.			Imports.			Re-Exports.		
	Electrical exports for Dec. 1929.	Inc. or dec. as compared with Nov. 1929.	Inc. or dec. as compared with Dec, 1928.	Electrical imports for Dec. 1929.	Inc. or dec. as compared with Nov, 1929.	Inc. or dec. as compared with Dec, 1928.	Electrical re-exports for Dec, 1929.	Inc. or dec. as compared with Nov, 1929.	Inc. or dec as compared with Dec, 1928.
Electrical goods and apparatus (unenumerated)	£276,503	−£59,218	+£59,736	£194,371	−£18,706	+£55,223	£13,941	+£3,982	+£6,683
Insulated wires and cables ...	280,785	− 93,817	+ 59,336	92,103	+ 1,501	+ 17,438	410	− 869	+ 27
Glow lamps	56,709	− 9,988	+ 9,327	86,798	+ 26,048	+ 64,103	1,016	− 285	− 374
Arc lamps and parts	2,150	− 2,063	+ 17	1,520	− 805	− 998	55	+ 41	+ 45
Batteries and accumulators ...	74,045	− 22,087	− 11,859	75,985	− 56,075	− 4,263	589	− 64	− 1,226
Meters and instruments ...	28,281	− 5,175	+ 6,181	142,564	+ 89,265	+ 118,332	362	− 335	− 243
Carbons	505	− 1,774	+ 94	11,283	+ 749	+ 1,420	22	− 55	− 309
Switchboards (not telegraph or telephone)	4,574	− 2,821	− 1,143	242	+ 230	+ 88	14	+ 6	− 4
Electrical Machinery—									
Electrical machinery (unenumerated)	278,455	− 56,765	− 30,956	191,455	+ 30,265	+ 41,082	12,160	− 1,230	+ 3,563
Railway and tramway motors	16,836	− 2,326	− 150	—	—	—	—	—	—
Other motors and generators...	242,626	+ 22,893	+ 56,249	—	—	—	—	—	—
Telegraph and Telephone Cable and Material—									
Telegraph and telephone wires and cable (not submarine)	98,217	+ 38,922	+ 41,626	1,440	− 859	− 2,258	—	—	− 8
Submarine telegraph and telephone cable...	84,340	+ 54,303	+ 33,203	—	—	− 5,950	—	—	—
Telegraph and telephone instruments and apparatus ...	267,854	+ 24,748	+ 54,781	113,782	− 57,742	+ 9,461	3,485	− 7,668	+ 1,587
Totals	£1,711,880	−£115,168	+£276,442	£911,543	+ £13,871	+£293,678	£32,054	− £6,477	+£9,741

Table II.—Exports of Electrical Machinery.

Destination.	Dec., 1928.	Dec., 1929.	Inc. or dec.	1928.	1929.	Inc. or dec.
	£	£	£	£	£	£
European Countries	93,364	141,642	+ 48,278	1,094,081	1,270,414	+ 176,333
Japan	2,522	9,596	+ 7,074	181,779	232,257	+ 50,478
South America	37,080	31,406	− 5,674	773,797	497,131	− 276,666
South Africa	53,403	65,349	+ 11,946	465,024	511,236	+ 46,212
British India	118,432	105,361	− 13,071	1,512,511	1,386,760	− 125,751
Australia	54,404	77,756	+ 23,352	971,995	932,886	− 39,109
New Zealand	28,874	21,495	− 7,379	358,889	245,662	− 113,227
Canada	28,901	19,124	− 9,777	252,758	309,575	+ 56,817
Other Countries	95,794	66,188	− 29,606	1,081,426	971,195	− 109,931
Totals	£512,774	£537,917	+ £25,143	£6,692,260	£6,357,416	− £334,844

portant market for electrical machinery, in spite of a decrease of £125,751 in the total. A very encouraging feature of the figures is the strength of the European market which increased its share by £176,333. Japan also added £50,478 to her 1928 quota. Against this has to be set a serious decline

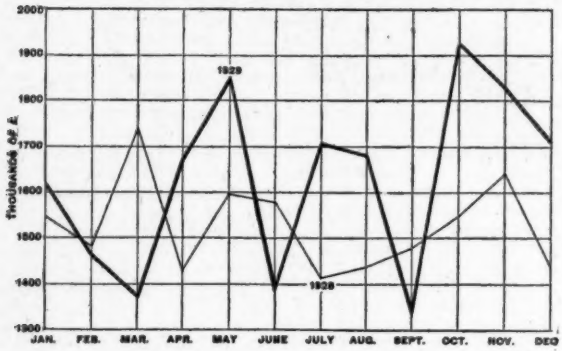
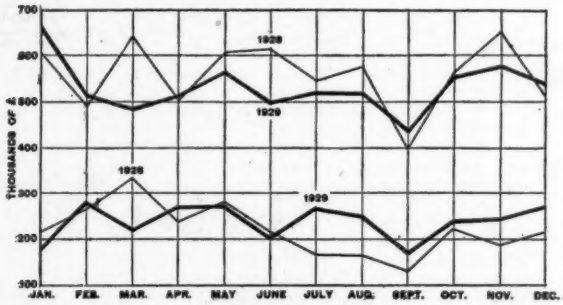


Fig. 1.—Monthly Exports during 1928 and 1929.

(£276,666) in the value of machinery sent to South America, and New Zealand's reduced purchases causing a fall of £113,227. Assuming "other countries" to be non-Empire markets, about 47 per cent. of the 1929 electrical machinery exports went to foreign countries, which is almost the same proportion as in 1928.



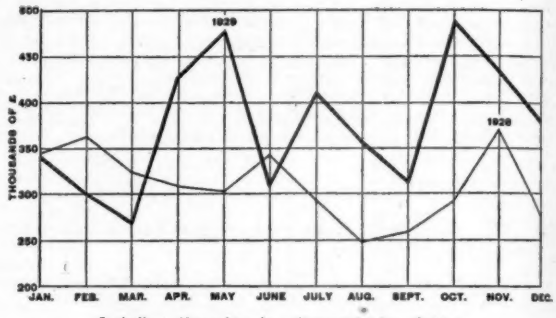
Upper curves: Electrical machinery.
Lower curves: Telegraph and telephone apparatus.

Fig. 2.—Two Leading Export Lines.

The totals for the past year are given in Table III. While it is satisfactory to note that we did not lose ground with regard to exports, it cannot be said that the increase of £1,213,311 was commensurate with the great growth of electrical development in all parts of the world. It is also a sign that things are not as they should be when imports rise to a greater extent than exports; whereas the exports showed an increase of about 6.6 per cent., the imports rose by no less than 30 per cent.

From the export list it is observed that the increase in the total was due entirely to greater exports of electrical goods and apparatus; electrical machinery exports fell in value by £334,844. The greatest individual rise was in the case of unenumerated goods (£682,135) which accounted for about 16 per cent. of the total. Their rise of £522,562 in the case of insulated wires and cables was satisfactory, as was the net increase of £298,401 in the telegraph and telephone section. Batteries and accumulators showed a decline of £86,388, while the variable item submarine cable fell in value by £183,164.

The large augmentation of imports was fairly general, there being only three small decreases. The principal feature of the list was the doubling of imports of telegraph and telephone apparatus, the actual increase being £901,785. It may



Including Non-submarine Communication Cables.

Fig. 3.—Exports of Insulated Wires and Cables.

be of interest to recall that the 1927 imports of this class had a value of only £487,468. Unenumerated goods, which again represent about 16 per cent. of the total, recorded a rise of £381,311. Other prominent increases occurred in the cases of meters and instruments (£228,532), unenumerated machinery (£162,500), batteries and accumulators (£119,414), and insulated wires and cables (£118,543).

In the re-export section, telegraph and telephone instruments stood out with a rise of £27,520.

The monthly fluctuations in our overseas electrical trade are illustrated by the curves accompanying these notes. In fig. 1 exports are dealt with, showing on the whole a better position than in 1928. A remarkable feature of the curves for the first seven or eight months of the year is the similarity of form, with the 1929 curve lagging by two months. Very high peaks are shown for May and October, the latter month's total being the highest reached for three years. It followed a very severe slump in September.

Two of the most important export classes are dealt with in fig. 2. The upper curves show how electrical machinery exports kept below the 1928 level during most of the period. There was a general tendency toward improvement in the last quarter of the year, the decline in December being much less

Table III.—Exports and Imports during 1928 and 1929.

	Exports.			Imports.			Re-exports.		
	Electrical exports 1928.	Electrical exports, 1929.	Inc. or dec. in 1929 as compared with 1928.	Electrical imports, 1928.	Electrical imports, 1928.	Inc. or dec. in 1929 as compared with 1928.	Electrical re-exports 1928.	Electrical re-exports 1929.	Inc. or dec. in 1929 as compared with 1928.
Electrical goods and apparatus (unenumerated) ...	£2,542,210	£3,224,345	+ £682,135	£1,496,082	1,877,393	+£381,311	£87,500	£110,502	+£23,002
Insulated wires and cables	2,868,014	3,390,576	+ 522,562	795,785	914,328	+ 118,543	12,200	9,487	— 2,713
Glow lamps...	532,582	662,530	+ 129,948	424.877	495,423	+ 70,546	10,671	12,083	+ 1,412
Arc lamps and parts ...	21,041	25,398	+ 4,357	37,234	23,217	— 14,017	414	649	+ 235
Batteries and accumulators	1,091,015	1,004,627	— 86,388	742,835	86 ,249	+ 119,414	9,288	11,743	+ 2,455
Meters and instruments ...	378,351	386,596	+ 8,245	279.866	508.398	+ 228,532	9,247	8,419	— 808
Carbons	13,726	11,378	— 2,348	128,339	15 ,081	+ 22,742	1,456	1,750	+ 294
Switchboards (not telegraph or telephone) ...	72,857	64,100	— 8,757	1,742	2,214	+ 472	373	98	— 275
Electrical Machinery—									
Electrical machinery (unenumerated)	3,784,417	3,764,882	— 19,535	1,713,430	1,893,930	+ 162,500	143,352	125,484	— 17,868
Railway & tramway motors	475,191	292,476	— 182,715	—	—	—	—	—	—
Other motors and generators	2,432,652	2,300,058	— 132,594	—	—	—	—	—	—
Telegraph and Telephone Cable and Material—									
Telegraph and telephone wires and cable (not submarine)	855,418	1,118,179	+ 262,761	71,071	43,055	— 28,016	827	2,019	+ 1,264
Submarine telegraph and telephone cable	630,301	447,137	— 183,164	5,950	—	— 5,950	—	4	+ 4
Telegraph and telephone instruments and apparatus...	2,623,620	2,842,424	+ 218,804	726,856	1,628,641	+901,785	35,311	62,831	+ 27,520
Totals	£18,321,395	£19,534,706	+£1,213,311	£6,442.067	£8,399,929	+£1,957,862	£310,619	£345.141	+ £34,523

severe than in December, 1928. The lower curves illustrate the sustained improvement in exports of telegraph and telephone apparatus during the past year, and here again the closing tendency was an upward one.

It must be mentioned that fig. 3 is on double the scale of the preceding curves, but even so there was a marked improvement in the monthly shipments of insulated wires

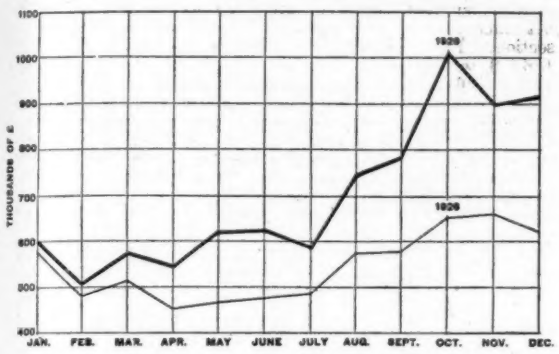
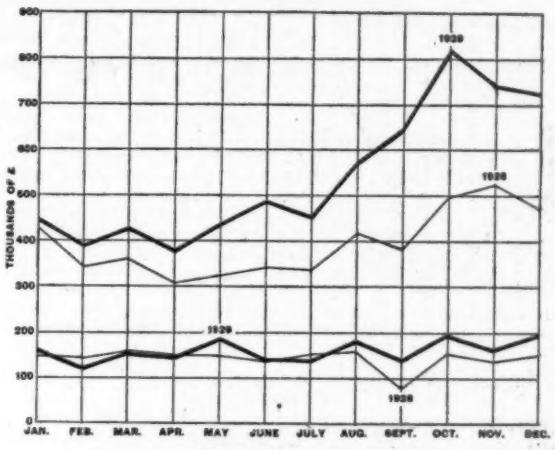


Fig. 4.—Monthly Imports during 1928 and 1929.

and cables (which in this case include non-submarine telegraph and telephone types). Very large exports were made in May and October and, as will be seen from fig. 1, these had a marked effect upon the totals of these months.

The most remarkable curves of the series are those in fig. 4, illustrating our electrical import trade. The gradual rise which was noticeable in 1928, was accelerated during the past year, and, as we have pointed out above, imports reached levels which had never been touched before. The analysis of the trade in fig. 5 shows that this tremendous increase was entirely due to large imports of electrical goods and apparatus (upper curves). The influence of machinery upon the general import



Upper curves: Electrical goods and apparatus.
Lower curves: Electrical machinery.

Fig. 5.—An Analysis of Imports.

curve was not very marked except that there was a hold-up in the rise in June due to a fall in machinery imports and a rise in these imports sustained the general curve in December, when imports of goods and apparatus fell slightly.

The Argentine Electrical Market.

Statistics of Import Trade: Important Developments Anticipated.

Argentina's Electrical Imports.

THE Argentine Government has only recently published detailed statistics of the import trade of the Republic, by countries of origin, for 1927. Those relating to electrical goods have been extracted and are shown below. Figures for 1926 are given in comparison and notes of increases or decreases added. The statement, although belated, affords some interesting indications. It is striking to see the number of countries—virtually all those possessing electrical manufacturing industries—that share in the trade. In most lines the United States strengthened its foothold in the year under review, while the trend of British sales suggests that they were due rather to big undertakings employing British capital than to the general electrical importer. For example, under the heading of "electrical apparatus not elsewhere indicated" Great Britain, with a smaller share than either the United States or Germany, was the only country in respect of which a decline was registered. It is disconcerting also to find Germany with a larger share of the trade in wire and cable and dynamos and motors than Great Britain.

	Gold pesos. (Thous.) 1926.	Gold pesos. (Thous.) 1927.	Gold pesos. (Thous.) Inc. or dec.
Accessories for underground cables—			
Total	143	92	− 51
From Germany	32	29	− 3
,, United Kingdom ...	77	46	− 31
Electrical accessories n.e.i.—			
Total	1,164	800	− 364
From Germany	202	292	+ 90
,, United States	136	127	− 9
,, United Kingdom ...	804	336	− 468
Accumulators—			
Total	78	263	+ 185
From United States	31	146	+ 115
,, United Kingdom ...	41	56	+ 15
Insulators of earthenware or porcelain—			
Total	243	158	− 85
From Germany	113	76	− 37
,, United Kingdom ...	96	65	− 31
Glass insulators—			
Total	570	2,590	+ 2,020
From France	530	1,875	+ 1,345
Electric wire and cable—			
Total	7,271	7,404	+ 133
From Germany	2,781	3,138	+ 357
,, Belgium	165	420	+ 255
,, United States	525	730	+ 205
,, Italy	540	530	− 10
,, United Kingdom ...	2,923	2,172	− 751
Ammeters and voltmeters—			
Total	140	70	− 70
From Germany	41	29	− 12
,, United States	83	34	− 49
Telephone apparatus—			
Total	274	152	− 122
From Germany	30	22	− 8
,, United Kingdom ...	183	81	− 102
,, Sweden	39	30	− 9
Telegraph apparatus—			
Total	16	6	− 10
Clamps and porcelain tubes—			
Total*	17	24	+ 7
Pushes for electric bells—			
Total*	14	15	+ 1
Electric bells—			
Total*	57	50	− 7
Electric light carbons—			
Total*	10	8	− 2
Insulating tape—			
Total	109	158	+ 49
From Germany	5	12	+ 7
,, United States	84	120	+ 36
,, United Kingdom ...	9	14	+ 5
Switches—			
Total†	195	88	− 107
Cut-outs and fuses—			
Total	37	29	− 8
From United States	16	9	− 7
,, United Kingdom ...	5	4	− 1

	Gold pesos. (Thous.) 1926.	Gold pesos. (Thous.) 1927.	Gold pesos. (Thous.) Inc. or dec.
Switchboards for bells and telephones—			
Total*	10	11	+ 1
Dynamos and motors—			
Total	1,920	2,020	+ 100
From Germany	1,150	1,105	− 45
„ Belgium	22	177	+ 155
„ United States	182	212	+ 30
„ Italy	99	123	+ 24
„ United Kingdom	173	197	+ 24
„ Sweden	147	115	− 32
„ Switzerland	74	58	− 16
Vulcanised fibre—			
Total	38	42	+ 4
From Germany	7	8	+ 1
„ United States	20	24	+ 4
„ United Kingdom	10	10	−
Circuit breakers—			
Total	19	32	+ 13
From Germany	11	9	− 2
„ Belgium	—	14	+ 14
„ United States	5	6	+ 1
Quick-break switches—			
Total	186	162	− 24
From Germany	82	81	− 1
„ Belgium	28	13	− 15
„ United States	30	25	− 5
„ United Kingdom	21	20	− 1
Incandescent lamps—			
Total	740	783	+ 43
From Germany	185	221	+ 36
„ United States	140	102	− 38
„ Holland	265	268	+ 3
„ United Kingdom	38	61	+ 23
Electrical apparatus n.e.i.—			
Total	1,164	1,375	+ 211
From Germany	297	338	+ 41
„ United States	380	415	+ 35
„ United Kingdom	290	260	− 30
„ Sweden	8	98	+ 90
Wireless telephone material—			
Total	661	1,566	+ 905
From Germany	17	575	+ 558
„ United States	350	637	+ 247
„ Holland	145	200	+ 55
„ United Kingdom	73	81	+ 8
Wireless telegraph material—			
Total‡	1	64	+ 63
Telegraph material—			
Total	52	17	− 35
From United States	13	5	− 8
„ United Kingdom	29	3	− 26
„ Sweden	6	4	− 2
Telephone material—			
Total	79	73	− 6
From Germany	26	4	− 22
„ United States	2	7	+ 5
„ United Kingdom	47	55	+ 8
Electric meters—			
Total	916	417	− 499
From Germany	490	200	− 290
„ Belgium	119	11	− 108
„ United States	6	42	+ 36
„ France	145	64	− 81
„ United Kingdom	149	98	− 51
Small motors—			
Total	235	270	+ 35
From Germany	77	79	+ 2
„ United States	114	155	+ 41
„ France	13	20	+ 7
Batteries—			
Total	671	978	+ 307
From Germany	85	99	+ 14
„ Denmark	11	36	+ 25
„ United States	528	798	+ 270
„ United Kingdom	37	35	− 2
Parts for batteries and accumulators—			
Total	544	467	− 77
From Germany	50	74	+ 24
„ Belgium	66	68	+ 2
„ United States	283	210	− 73
„ United Kingdom	114	66	− 48
Porous jars for batteries—			
Total†	8	16	+ 8
Glass jars for batteries and accumulators—			
Total	17	27	+ 10
Lampholders—			
Total*	187	172	− 15
Distribution boards—			
Total ●	96	26	− 70
From United States	3	12	+ 9
„ United Kingdom	79	5	− 74
Plugs—			
Total*	19	11	− 8
Wall sockets—			
Total	10	8	− 2
Insulating tubes—			
Total	613	780	+ 167
From Germany	331	487	+ 156
„ United States	131	140	+ 9
„ United Kingdom	128	143	+ 15
Electric fans—			
Total	93	163	+ 70
From United States	23	64	+ 41
„ Italy	50	76	+ 26

Gold peso=4s.

* Mainly from Germany.
† „ „ United Kingdom.
‡ „ „ United States.

Rapid Electrical Progress Forecast.

REFERRING to the recent inauguration of the large power station of the Cia. Hispano-Americana de Electricidad in the New Port of Buenos Aires and to the rapid progress being made with the new super-station of the Italo-Argentina Co., the *Review of the River Plate* says that these items justify the expectations of truly extraordinary developments in the Argentine electrical field. Our contemporary also mentions the recent registration of three companies of an electrical character with a combined capital of $18,000,000,* and proceeds as follows:—The use of electricity for lighting, as well as for the many devices that make for pleasure, comfort and convenience is rapidly increasing in Argentina, and it is little to say that the people of Argentina are to such an extraordinary degree electrically minded that this phase of development is significant of one of the greatest industrial opportunities which Argentina has to offer to the world to-day. The present process of electrification is international, but in Argentina's case there is the important difference that against the impediment of tradition and humbug which has been opposed to electrical progress in many of the European countries, there exists an eager spirit of modernity which contemptuously scoffs at any or every tradition that may happen to conflict with the purely practical aspects of existence. Electrical enterprise in Argentina is now entering upon the secondary phase of its evolution. It is little more than a year since the shares of the then existing electrical enterprises, other than the two principal concerns operating in the capital, were attracting considerable attention owing to the understanding of possible American purchases, reorganisation of capital or other happenings which, in addition to the, for the most part, satisfactory rate of current earnings, suggested possibilities of profit through capital appreciation. It is unquestionable that considerable profits were taken, and as some of the enterprises changed and embarked upon their new *régime*, there was a tendency on the part of those who had seen an opportunity come and go, to believe that the principal chapter had been written, or at any rate that it would be a tiresome business to wait for a recurrence of similarly attractive opportunities. It is quite on the cards, nevertheless, that the secondary phase of electrical evolution in Argentina will be as rich in opportunities as the first. There are in being or in prospect new electrical ventures which present to the investor opportunities neither more nor less attractive than those which the now tremendously prosperous electrical enterprises must have suggested to their original proprietors in the early days of electrical development in this country. In the smaller towns and villages of Argentina there is a scope of development which presents an opportunity equivalent to that which met its response when the first electric light and power plant was installed in the capital of the Republic. The possible trend may be estimated by what has actually happened in some European countries which are not exactly noted for their dynamic qualities.

* *Vide* ELEC. REV., January 10th, p. 68.

Domestic Hot-water Supply.

The Fourth E.D.A. Salesmanship Conference of the Season.

THE third E.D.A. Salesmanship Conference of the 1929-30 Session took the form of a display of kinematograph films. The fourth was held on January 17th. Lieut.-Colonel W. A. VIGNOLES (Director and Secretary, E.D.A.) presided in place of Sir Hugo Hirst, who is now convalescent after his recent illness. In opening the proceedings, the chairman referred to the death of Dr. Ferranti, and the meeting stood in silence for a brief period as a mark of respect.

Mr. C. HUBERT SMITH, A.M.I.E.E., then presented a paper containing descriptions of small and medium-sized electric hot-water installations for flats, private houses and offices. Mr. Smith emphasised, in the first place, that there was now available some form of electric water heating system which would meet almost any set of conditions that arose; the problem was merely a matter of understanding those conditions and choosing the best system. The first necessity was to find out what arrangements could be made for supplying the cold water. Assuming that water was available from a ball valve cistern and hot water was required at one point only, a thermostatically-controlled displacement type heater with bottom feed would meet requirements, the control being on the cold water inlet, and the hot water passing out through an always open spout to the receptacle. If hot water was required at more than one point, the same type of heater could be used, it being provided with a union for the reception of the hot water pipe connection to the several points, and a union at the bottom for the cold water feed from the cistern. If no cold water cistern was available and hot water was required at one point only, he recommended a type of tank with broken feed arrangement, the control being on the inlet, with the outlet spout always open. Where no ball valve cistern was available, and it was inconvenient to fit one, and hot water was required at several points, it was best to use a cistern type of tank.

The amount of water likely to be required in a house should be ascertained before proceeding with an installation, and a liberal estimate of cost should be made. The standing cost incurred in keeping a tank of hot water ready for instant use day and night could be taken at an average of one kWh per 24 hours. For 24-gallon hot baths at 105 deg., four kWh per bath would be required; for wash basins one-third kWh per wash; and for washing up and scouring, one kWh per three gallons. He estimated that the consumption per week by a household requiring an average of one bath, six hand-basin washes and 15 gallons of water for general domestic use daily, plus standing loss, would be 84 kWh.

Existing hot water systems could be converted by fitting immersion heaters in storage tanks in some cases, but it was important to trace all the pipe connections before coming to a decision. If the system was small and compact, a 2-kW immersion heater could be fitted in the tank, controlled thermostatically or by a series parallel switch. A heater could be provided as an auxiliary to a slow combustion stove situated in the kitchen. The tank should be heat insulated. Where immersion heaters were hand controlled, it was advisable to fit an indicating lamp. An immersion heater in an existing hot water storage tank as an auxiliary to a coke furnace could be used in much larger premises. For example, in a block of office buildings or flats centrally heated by a coke boiler and hot water radiators, an electric circulator could be fitted in parallel with the furnace. A time switch of small current-carrying capacity would be inserted in the thermostat-operating coil circuit of the main contactor. Another system was to fit a thermostatically-controlled water heater in conjunction with a solid-fuel boiler.

A number of layouts of hot-water supply systems to blocks of flats were also given in the paper, and Mr. Smith pointed out that large blocks of flats were being supplied with hot water electrically heated. Although the cost of energy was higher than the actual cost of coke, the latter was only a fraction of the total overall cost. There had to be considered the space occupied by the boiler house, the chimney, the distribution piping, the possible annoyance to tenants by smoke and dust, the labour involved in stoking, the entire dependence upon the efficiency of the person responsible for stoking, the storing of coke and many other incidental points. The electrical system was very flexible, it would meet demands more promptly, and the personal factor was eliminated entirely. Typical examples were given of groups of flats equipped with a central calorifier, the hot water supply being *ad lib.* and included in the rental. In one case the average weekly consumption per flat was 217 kWh, and in another 228 kWh. The fitting of separate tanks in each flat had been found the best system. The author mentioned five typical flats equipped with lighting, heating, cooking, and water heating. The landlord paid the standing charge, which was included in the rent. One meter was fitted in each flat registering all energy consumed, the charge being ½d. per kWh. The hot water tanks were considered as fixtures and part of the flat equipment, the landlord meeting the cost. The tenants hired the cookers, fires, &c. The average consumption per flat per week was 200 kWh, costing 8s. 4d. In five similar flats equipped with lighting, heating, and water heating (no electric cookers) the average consumption per week was 98 kWh, and the cost 4s. 1d.

In conclusion, Mr. Smith said that although electric geysers or instantaneous water heaters had a certain field of usefulness, where small quantites of water were required intermittently, they could almost be left out of consideration as a means of meeting the general demand for hot water.

Discussion.

In the ensuing discussion, Mr. STEELE said that the present cost of electricity was hindering water heating; he considered that ½d. per kWh was the maximum rate.

Mr. W. A. GILLOTT was also concerned about the cost of installations and energy.

Mr. C. G. NOBBS, after making a plea for the collection of more definite information concerning the subject, said that for small domestic hot-water single-pipe systems the consumption would probably average 2 kWh per person per day, though in individual families the consumption of water varied greatly. A temperature exceeding 150 deg. F. was unnecessary for domestic purposes. Local storage, "push" system or displacement water heaters should have anti-drip siphon or other arrangements to prevent loss of water by expansion during heating up. Where live circulation mains were necessary the provision of a stop valve in the return pipe enabled a big saving to be effected.

Mr. F. SELLEY said that the load factors of the stations in London and Greater London could be greatly improved by water heating. He had found that if consumers were given supplies for water heating *ad lib.* the load was a non-peak load, and, by governing with time switches, he had found that there were 8 or 9 hours per day to spare for building up the load. It was time that supply authorities got together to ascertain what was the lowest rate which they could make for off-peak loads.

Mr. E. SHARP said that the question of the quantity of water used must be considered in conjunction with that of temperature.

Mr. A LEADBEATER (Hampstead) said that for the last two years water heaters of the types referred to by Mr. Smith had given every satisfaction in his district; he was now supplying more water heaters than cookers. Cost was not everything; many people did not mind if their hot water cost them an extra 1s. or 2s. per week provided they had the convenience and the reliability of electric water heating.

Mr. HONEY (Croydon) said that in Croydon between 1,300 and 1,400 water heaters had been sold since 1925. He was glad to note that supply authorities were beginning to reduce their prices towards the figure of ½d. per unit; the rate in Croydon was 0.75d., on the two-part tariff. Figures obtained in Croydon showed that for an average small house with an 11-gallon heater the consumption was about 5 kWh per day. Night heating had been tried in Croydon, but it was difficult to provide sufficient storage capacity.

Mr. RITCHIE (Hendon) said he had an electric heater working in conjunction with a coke boiler. There were usually four inhabitants in the house, and sometimes five, and the consumption was 15 kWh per day in the summer and 8 kWh per day in the winter.

THE CHAIRMAN, referring to his own installation, consisting of an immersion heater fixed in a tank in a linen cupboard, said the consumption in summer, when electricity only was used, was about 12 kWh per day, but if the tank were lagged efficiently the consumption would be less. He emphasised that people were prepared to buy things on a basis other than that of low cost, and this was where salesmanship came in. At his house a coke fire was used for water heating in winter because it helped to warm the kitchen as well, but at night the electric heater was switched on.

Mr. SMITH, replying to the discussion, considered that the consumption of 15 kWh per day, mentioned by Mr. Ritchie, was rather high, but much depended on the run of the pipes. The consumption of 5 kWh per day, mentioned by Mr. Honey, was fairly satisfactory. Mr. Sharp's weekly consumption would be 186 units which was high. If the water were supplied at a fairly high temperature, say, 175 deg. F., the consumption of water would probably have been less. Referring to the cost of energy he said that at 1d. per kWh there was some hope, at ¾d. there was a lot of hope, and at ½d. it was easy. They should, however, consider that electric water heating was well worth its cost; the lower cost of other methods was not the whole story.

The Physical Society's Exhibition—II.*

Annual Display of Electrical Instruments and Scientific Apparatus.

Everett, Edgcumbe & Co., Ltd.

The material advances in current transformer design have been made recently by the company in two distinct directions. The one includes a precision hitherto unheard of for standardisation laboratory purposes; a current transformer as recently supplied to the National Physical Laboratory, Teddington, was exhibited which, from 10 up to 150 per cent. of its rated current, had a ratio correct to within one part in 10,000,

Fig. 1.—Pivot " Bumping " Test Results.

and the phase displacement amounts to barely 0.8 minute. These transformers, which can be supplied for any current, have made possible current and power measurements up to 5,000 amperes, or more, with an accuracy not attainable by any other means; they can be supplied in the single-range, multi-range, and omni-range patterns. The other innovation is a large output from bar-type current transformers for small rated currents of 50 to 100 amperes. It has, at the same time, introduced a line of measuring, recording, and protective instruments of which the volt-ampere consumption has been reduced to a fraction of the usual value, so that a number of such instruments can be operated from a low-current bar-type transformer. For example, a 150-ampere bushing transformer was exhibited, operating an ammeter, a graphic ammeter, and a directional relay.

Satisfactory pivoting involves a good pivot, a good jewel, and strictly limited pressure between them, and the company seems to have appreciated the correct combination of all three. For the jewels themselves, a tough sapphire, well polished and having a truly spherical cup, was adopted in combination with a high-carbon steel (to give great toughness) devoid of free carbide (to minimise abrasion) produced after suitable heat treatment to make pivots of very remarkable properties. Fig. 1 shows the effect of rough treatment upon a normal pivot, such as had previously been regarded as good, and one of the latest pattern, after each had undergone precisely the

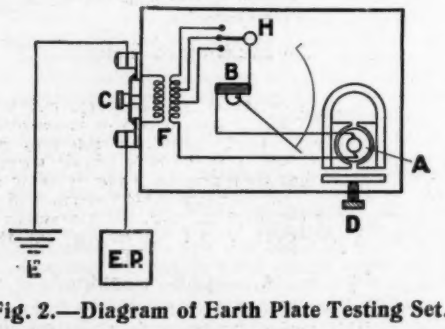


Fig. 2.—Diagram of Earth Plate Testing Set.

same rough treatment. Makers have long striven to minimise friction and prevent wear by reducing the weight of the moving parts, but it is not so much the dead weight which does the damage as the repeated hammer blows due to the inertia of the moving parts. This trouble has been overcome by the expedient of mounting the jewel with a light spring behind it and, above all, of ensuring that the weight of the jewel itself is a mere fraction of that of the moving parts, so that, whether as the result of a blow or of persistent vibration, the pressure between the pivot and the jewel cannot possibly exceed a safe value, and unlimited hammering has no ill-effects. The relative importance of these requisites is well shown in fig. 1, a photo-micrograph of three pivots after undergoing a " bumping " test, probably equivalent to from 10 to 20 years' normal use, *viz.*, a so-called " hardened steel pivot," as normally used in measuring instruments, mounted in a

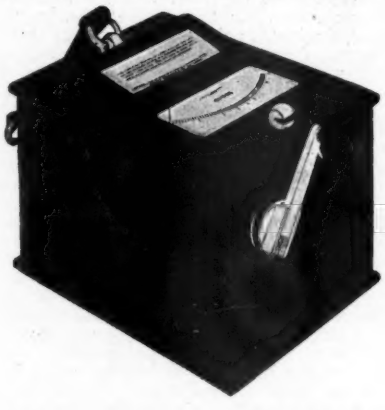


Fig. 3.—Earth Plate Testing Set.

rigidly-held jewel; an Everett-Edgcumbe high-carbon pivot mounted in a rigidly-held jewel; the same pivot, but mounted in an Everett-Edgcumbe sprung jewel.

The maintenance of truly correct instantaneous frequency is, in practice, almost impossible, since transitory variations are bound to occur with sudden changes of load, whereas the maintenance of a constant *mean* frequency with the master frequency meter is a very simple operation. The company's system was given a practical test at the exhibition, where one of its master frequency meters was installed in conjunction with the rotary convertor which supplied the alternating current used on the stands. The load was necessarily a very variable one, and last year considerable trouble was experienced by exhibitors owing to the unsteady frequency, so that its proper regulation this year was much appreciated.

To ensure that frequency is properly maintained throughout the 24 hours, not merely corrected at intervals, no existing graphic frequency meter has been anything like accurate

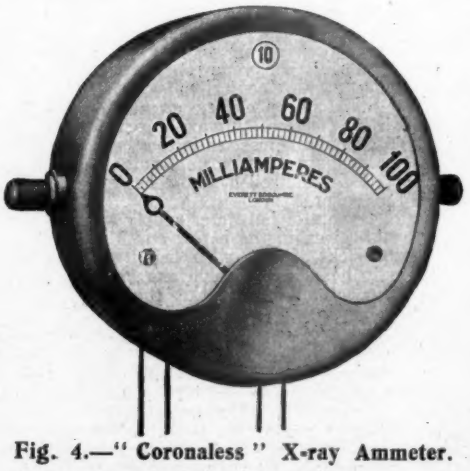


Fig. 4.—" Coronaless " X-ray Ammeter.

enough and the company has accordingly developed an instrument based upon an entirely novel principle. A continuously running synchronous motor is geared to the inking arm of an " Inkwell " grapher for a period of two minutes at a time and then released again. During the time that it is geared to the inking arm the latter is carried forward across the chart, tracing a line of a length proportional to the number of revolutions made by the motor in a given time, and therefore to the frequency. At the end of each period the pen drops back, and

* Part I of this series was published in our January 17th issue.—EDS. ELEC. REV.

the result is a series of parallel lines, the terminal points of which accurately represent the frequency. The scale can be "set-up" to any desired extent; in fact, full deflection on either side of the normal frequency can be obtained with a difference of only one cycle. The advantage of this instrument is that the indication depends upon nothing but the number of alternations of the current and upon the time. From the former it follows that the indications are entirely independent of wave-form, voltage, temperature, &c., and the time intervals depend upon the time-keeping of a clock, which is accurate to

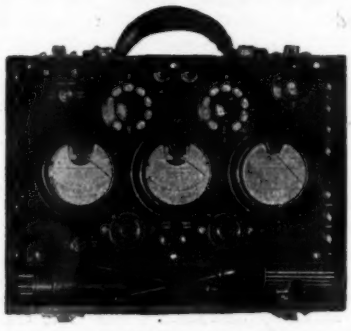


Fig. 5.—Radio Set Tester.

a very small fraction of 1 per cent.; the overall accuracy is, in fact, about 0.1 per cent.

A compact earth plate testing set operates upon a new principle, *i.e.*, the provision of a constant voltage by means of a governed alternating-current motor-generator of which the speed is unaffected, however fast the handle may be turned, and a sensitive ammeter graduated to read direct in ohms. The use of alternating current in this way makes the indications entirely independent of polarisation, earth currents, elecrolytic e.m.f.'s, &c.; in fact, with the set exhibited, it was shown that a 2-volt accumulator could be connected in circuit without in any way affecting the readings. Fig. 3 shows the appearance of the instrument and fig. 2 its internal arrangements. The a.c. generator is indicated at A, the ammeter at B, and a 1/1 transformer at F. Either one, two, or three ranges can be given, as desired, and they are thrown into circuit by means of the switch H, usual ranges being 0-15, 0-150, or 0-1,500 ohms. When a good earth is available against which to test, the measurement can be made direct, but otherwise artificial testing earths are employed.

The increased voltages now used in X-ray tubes have resulted in serious losses due to corona effects, to obviate which it has become customary for all high-voltage parts to be carefully rounded off. That practice has not, however, in the past applied to the measuring instruments themselves, but Messrs. Everett, Edgcumbe have now introduced a line of "Coronaless" instruments, of which all corners, terminals, &c., are carefully rounded, so that there can be no brushing whatever, even at the highest voltages used. The instruments, a moving-coil example of which is shown in fig. 4, embody two other novel features: one is a range-changing switch operated by a pair of insulating cords, whereby the instrument can be mounted overhead, whilst the range is changed from below without any fear of shock; the other new feature is a device that enables currents to be measured however short the time. With short X-ray exposures the measurement of the current is a matter of real difficulty, since the pointer of the ordinary ammeter will often not have reached its position of rest before the circuit is again broken; even if it has done so, reading the momentary indication of a rapidly moving pointer is a matter of consderable difficulty. This trouble is overcome by the provision of an adjustable back stop for the pointer, which is likewise movable by means of two insulated cords. In using this device, the pointer is set by means of the stop at a point on the scale just below that corresponding to the current which it is intended to pass through the X-ray tube, and the passage of that current, no matter how short the exposure, will cause the pointer to leave the stop and move slightly up the scale, thus indicating clearly, even in bad light, that the correct current has been passed through the tube.

An interesting exhibit of an inkless graphic recorder was shown, similar to a number recently supplied to a large power station for the accurate logging of the temperature of outgoing cables. Above, and just clear of, the chart moves a light steel rod, carried by a galvanometer pointer and depressed at short intervals on to a typewriter ribbon, thus making a dot at a point exactly corresponding with the position of the galvanometer pointer. The driving of the charts and the depressing of the marking point are both of them effected by means of a Warren synchronous motor, which takes the place of the ordinary spring-driven clock, and at a chart speed of 1 in. per hour obviates all winding or other attention for a period of four weeks, besides ensuring absolute synchronism between the records obtained on any number of instruments. The temperature measurement is effected by means of a nickel loop, kept in close proximity to the cable whose temperature is to be determined, which forms one arm of a Wheatstone bridge. The chart co-ordinates are rectangular and the range is 20-70 deg. C., so that, the chart being 4 in. wide, 1 deg. corresponds to just over 1/12 in.

Weston Electrical Instrument Co., Ltd.

The selection of measuring instruments shown by this company included Model 547 tester (fig. 5) designed for the service requirements of all type of radio receivers. It will measure the various a.c. and d.c. voltages used, either at the valve sockets or at any part of the set; also continuity, condition of circuits, and valves, including a.c. or d.c screen-grid types, under the same conditions as exist when they are in their sockets. All tests can be made by using the regulator voltages normally supplied to the set by its batteries, or socket power units, with no change in connections, so that no auxiliary power supply is required. It will also measure the voltage of plate transformers up to 750 volts on either side of the centre tap. The test set consists of three instruments, a d.c. milliammeter, a d.c. volt-milliammeter, and an a.c. voltmeter, and is provided with various switches, plugs, and cords for properly connecting the instruments to the circuits under test. The a.c. voltmeter has five ranges: 750, 150, 16, 8, and 4 volts. Any of the three lower ranges can be connected directly across the filament terminals of the tester plug by setting the a.c. selector switch to the desired range. The ranges are for the purpose of measuring the filament or heater voltages of valves whose filaments are heated with unrectified "raw" a.c. The 150-volt range is provided for the purpose of measuring the line voltage, and the 750-V range for measuring the voltages of transformer secondaries. The d.c. volt-milliammeter has eight ranges: 750, 250, 100, 50, 10, and 5 volts, and 100 and 5 milliamperes. The 750 and 250 ranges are for plate voltage measurements; the 100, 50, and 5 are for grid-bias readings; the 50 range is also used for cathode voltage readings; the 10-volt range is for filament-voltage readings, and the 5-volt range is also used for continuity tests. The 5-milliampere range is for use when measuring the screen current of screen-grid valves, and the 100-milliampere range for measuring the plate current of rectifier valves. All voltage ranges are available at the binding posts.

The d.c. milliammeter has two ranges: 100 and 20 milliamperes. Either may be used by throwing a toggle switch to 100 mA or 20 mA, which two ranges are also brought out to binding posts. Shunts can be obtained to increase the range of the milliammeter to 2 or 10 amperes. The two-ampere range is for measuring current in dynamic speaker field coils, trickle chargers, &c., and the 10-ampere range for measuring larger currents, such as charging range of 5- or 7.5-ampere charges, &c. Two bi-polar switches are provided to connect the d.c. volt-milliammeter to the various circuits as designated on the dials. They are arranged in such a manner that the instruments cannot be connected across any two circuits at the same time. A smaller switch is provided for use in selecting the desired a.c. filament voltage ranges for connecting the a.c. voltmeter directly across the filament terminals.

Model 301 multi-range tester (fig. 6) is mounted in a specially designed stand and should prove extremely useful for general

Fig. 6.—Multi-range Tester.

testing when great accuracy is not necessary, but a reliable instrument capable of standing hard service is essential. The ease and rapidity with which continuity tests may be made will appear to all who may have to check wiring. The sensitivity is such that tests may be made by using a single dry cell, because 1 volt through 50,000 ohms will give a deflection of one scale division, and the movement of the pointer is easily perceptible with 1 volt through 500,000 ohms.

Mr. R. M. Catterson-Smith.

An automatic twin-tube furnace for the continuous delivery of billets suitably heated for hot pressing at controlled intervals of from 8 seconds upwards per billet was demonstrated. The required temperature is automatically maintained while billets are fed from hoppers by solenoid-actuated push rods into preheating tubes furnished with nickel-chrome windings, and final heating is provided by silit rods at the delivery end; the efficiency of the furnace is in the region of 75 per cent. A continuous rotary furnace for small tools and other articles requiring uniform heat treatment, maximum temperature 1,200 deg. C., and Dr. Gordon Campbell's dental furnace with a heated door were also on view.

The Electricity Commissioners' Work.

Extracts from their Ninth Annual Report, 1928-29.

(*Concluded from page* 115.)

Fringe Orders.

The Commissioners granted 116 Orders during the year permitting various authorised undertakers to supply electricity to specific premises situated outside their respective areas of supply. They revoked nine Fringe Orders on being satisfied that the undertakers in whose area of supply the particular premises were situated were in a position to give a supply to the premises on reasonable terms and had come to an agreement as to the taking over of the supply from the undertakers then supplying under the Fringe Order.

Compensation for Loss of Office.

In June, 1928, a Bill was introduced with the object of securing an amendment of the provisions relating to compensation for deprivation of employment, &c., contained in Section 16 of the Electricity (Supply) Act, 1919, by the abolition of the requirement that a claimant under the said provisions must have been employed in or about the undertaking or any authorised undertaking before May 8th, 1919. The Bill was enacted on December 19th, 1928, under the title "Electricity (Supply) Act, 1928."

Apart from three proceedings before the Commissioners, a number of claims for compensation were dealt with by the referee appointed by the Minister of Labour.

The awards made were as follows:—12 claims, £447 total; seven claims, £1,693 total; seven claims, £741 total; 12 claims, £716 total; eight claims, £1,408 total; 13 claims, £3,131 total; and three claims, £718 or £764, depending upon the decision of the Court as to whether previous employment in other authorised undertakings could be taken into account.

Experimental Work and Research.

The Commissioners contributed £1,000 to the B.E.A.I. Research Association towards the cost of the investigations into (*a*) the question of wind pressure on lattice towers and (*b*) the use of reinforced concrete poles for overhead lines, with particular reference to the question of factors of safety.

Charges for Electricity.

While several additional applications for downward revisions of maximum prices were made to the Minister of Transport during the year under review, there was some falling off, as compared with the previous year, in the number of representations and complaints addressed to the Minister and the Commissioners on the subject of the prices charged for electricity by authorised undertakers in different parts of the country.

In connection with the investigations of the Conference on Electricity Supply in Rural Areas, the sub-committee which dealt with this subject came to the conclusion that there were no special characteristics of any of the two-part tariffs hitherto devised which could be regarded as rendering a particular tariff pre-eminently suitable for rural as contrasted with urban development, and expressed the opinion that it would be conducive to electrical development in general if supply authorities would co-operate and effect a reduction in the number of optional tariffs at present in vogue, so as to bring about greater uniformity in methods of charge.

At the commencement of the year, eight applications for revisions of maximum prices were under consideration, seven of the applications seeking downward revisions, and the other application an upward revision. In the course of the year, 10 further applications were made to the Minister of Transport for downward revisions of maximum prices.

Overhead Lines.

There was a substantial increase in the number of applications from undertakers in general for the consent of the Minister of Transport to the erection of overhead lines.

The Commissioners dealt in all with 560 applications during the year, an increase of as many as 169, or 43 per cent., on the previous year. The former figures are exclusive of a number of applications still under consideration by the Commissioners.

The Minister gave his consent in 545 cases, inclusive of certain prior applications which had not been finally dealt with at the end of the previous year. Of these consents, nine were given to the Central Electricity Board, 165 to local authority undertakers, 211 to electric power companies in respect of Power Act and/or distribution developments, and 160 to other company undertakers.

The Commissioners dealt in all with 89 wayleave applications during the year, as compared with 107 cases in the previous year. The former figure is exclusive of a number of applications still under consideration by the Commissioners. Owing to settlements being arrived at between the parties concerned, 30 applications were withdrawn.

In another case where a compulsory wayleave was sought in respect of electric lines erected across certain property, the Minister notified the parties concerned of his views as to an appropriate wayleave rental, and a settlement was effected on that basis without the application being further proceeded with.

In the case of 59 applications, the Minister gave his consent to wayleaves after local inquiries had been held, two of the consents being given to the Central Electricity Board, 15 to local authority undertakers, and 42 to company undertakers. The remaining eight applications were still under consideration by the Minister.

Private Parliamentary Bills.

The Commissioners, on behalf of the Minister of Transport, examined the provisions relating to the supply of electricity included in the Private Bills and Scottish Provisional Orders deposited for the Session of 1929; in 54 cases they advised the Minister in connection with the reports required to be made by him in accordance with the Standing Orders of Parliament.

National Fuel and Power Committee.

The report of the National Fuel and Power Committee, issued in September, 1928,* dealt with various aspects of the fuel problem in Great Britain, and contained observations or recommendations on two broad questions relating to the public supply of electricity in the country.

The first question had reference generally to the part which could be taken by colliery organisations in electrical developments in their respective districts, and more particularly to the utilisation of fine slack coal and low grade fuels for the generation of electricity for public supply purposes.

The observations of the committee on the question of pithead generation may be contrasted with the popularly-held assumption that all electricty for public supply purposes should be generated in power stations at the pithead. Although not specifically mentioned in the committee's report, reference may be made in this connection to one of the principal requirements for a cheaply operated capital station, namely, an abundant natural supply of circulating water for condensing purposes capable of being utilised without undue cost for pumping. It will be noted that the committee does not go so far as to concede that the power requirements of a colliery itself necessitate the establishment of a colliery power station in every case. The fact that the Commissioners have not hitherto found it necessary to provide that any colliery generating station should be a selected station, or for the acquisition by the Central Board of any transmission line belonging to a colliery company, does not preclude the co-operation of colliery undertakings in any electrical development under the regional schemes concerned. The Central Board is empowered to enter into arrangements with organisations, such as colliery companies, for the purchase of surplus electricity, waste heat, or other form of energy. It is in this manner, the Commissioners consider, that existing collieries are most likely to find an avenue for co-operation in electrical development under the new *régime*. An important factor will undoubtedly be the question of the cost at which the surplus energy can be delivered into the grid system of the Central Board, as compared with the cost to the Board of obtaining equivalent supplies from the selected generating stations already connected to the system. The Commissioners hope that in the case of future colliery developments it will prove possible for the electrical requirements of the collieries concerned to be met either wholly or mainly by supplies from the public system in the particular district. In this way the provision of further private generating stations for colliery purposes would be obviated or minimised.

The second question dealt with by the Committee had reference to the problem of finding a profitable outlet for surplus gas resulting from the operations of the coke-oven industry, the principal uses suggested for such gas being as a gas supply for towns or for producing electrical power.

No official particulars are available as to the extent to which use has hitherto been made of surplus coke-oven gas (as distinguished from other waste combustible gases), for the generation of electricity in Great Britain, but the evidence available shows that not more than a very minor proportion of the public supply of electricity can be attributed to the use of surplus coke-oven gas.

* ELECTRICAL REVIEW, September 28th, 1928.

The possibilities attaching to the further use of surplus coke-oven gas on any considerable scale for public electricity supply are affected by a number of considerations, such as the localised sources of this power station fuel, as compared with the wide choice available in the case of supplies of coal for steam power stations; the question of continuity of adequate supplies in view of the extra cost which would be involved if power stations had to be adapted for the alternative use of coal as a precaution against insufficiency of supplies of coke-oven gas; and the relative cost of the gas as a power station fuel.

Staff and Organisation.

As in the previous year, the Commissioners retained the professional services of certain consulting electrical engineers to assist in the technical investigations arising in connection with the preparation of schemes under the Act of 1926. To enable the increasing volume of administrative work to be dealt with, the Commissioners also found it necessary to make additional junior appointments to their staff. On March 31st, 1929, the staff of the Electricity Commission numbered 73 in all, and consisted of 37 established officers and 36 unestablished and temporary officers, inclusive of typists and messengers.

The estimate net cost of administration for the year 1928-29 was £50,450, inclusive of provision of £3,000 for unforeseen contingencies. After allowing for a reduction of £3,450 in the previous working balance, the total amount to be apportioned among authorised undertakers was £47,000, as compared with £44,000 in the preceding year. With regard to the apportionment of the estimate on the basis of "units of electricity sold," the certified returns submitted for the year ending December 31st, 1927, showed that 6,850,162,808 kWh were sold by authorised undertakers in Great Britain during that year. The corresponding figure for the year ending December 31st, 1928, was 7,603,240,446. The contributions by the electricity supply industry towards the expenses of the Commissioners for the year 1928-29 thus involved a payment of 1.65d. per 1,000 kWh sold by each authorised undertaker concerned.

The year closed with an increase in the working balance of £2,480, as against an estimated reduction of £3,450, the net expenditure thus falling short of the estimate by £5,930. This was mainly accounted for by the fact that the contingency provision of £3,000 was not drawn upon, by the increase in receipts due to fees on applications for Special Orders, and by the increased interest earnings on the larger cash balances in hand during the year.

In concluding the Report, the Commissioners record the appointment in March, 1929, of Sir John Brooke, C.B., Secretary of the Central Electricity Board, to the office of Electricity Commissioner.

Radio Receiver Performance.

An improved method of measuring overall amplification, which can be applied to practical cases, particularly at short wavelengths, and an analysis of the behaviour of typical receiving apparatus.

By H. A. THOMAS, M.Sc.

(*Extracts from a paper read before the* WIRELESS SECTION *of the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE paper describes researches which have been carried out at the National Physical Laboratory for the Radio Research Board. An improved method of measuring the amplification of a radio receiver is described and the manner in which it can be applied to practical cases, particularly at short wavelengths. The apparatus covers a wavelength range of from 5 to 30,000 metres, and is capable of dealing with inputs of from 0.25 to 1,000 mV over that range.

The aim of all measurements of the constituent parts of a radio receiver is ultimately to determine the characteristic relationship between the input and the output voltages, together with an analysis of the behaviour of the individual portions of the apparatus.

Most early attempts were based on an assumption that the overall performance could be represented in terms of the product of the performances of the separate components, but the effects due to the input impedance of an amplifying stage, together with the various forms of retroaction, render the assumption unjustifiable in all but the very simplest cases.

The input is supplied by means of an artificially generated signal, which is applied to the tuned input circuit by inserting in series with the latter a small non-inductive resistance, or a small inductance carrying a known current. This method has been adopted to a greater extent than others owing to its more general application and its comparative independence of frequency. A radio-frequency oscillation, modulated to a known extent at an audio frequency, supplies current to these potentiometer resistances. The prevention of direct magnetic and electrical induction from the oscillators and leads to the potentiometer demands the most elaborate screening of these components. This is effected by enclosing the oscillators in a completely screened metal room and screening the leads to the potentiometer. The amplifier, too, must be housed in a screened room to prevent induction from external sources. Refinement in measurement is dependent upon the efficacy of these screens, and practically nothing except complete shielding is permissible.

The potentiometer takes the form of a straight resistance wire with a concentric return, by which means complete shielding is effected.

The complete oscillator cabin consists of a wooden skeleton covered with tinned-iron sheet. Great care was taken to solder over every joint, and the completed box was hermetically air-tight. Screened doors were not sufficiently effective, and consequently a mercury-sealed trap door was adopted, consisting of a welded angle-iron frame dipping into a channel-shaped iron frame containing mercury. The output current leads are taken through seamless steel tubing. The ventilation of such a box presents some difficulty, the method adopted making use of two long copper pipes provided with three copper-gauze baffles, which give adequate screening while permitting a sufficient passage for air, connected by insulating rubber hose-pipe to a centrifugal pump so that the air pressure inside the box is only slightly lower than that of the outer atmosphere. The complete box is insulated from earth by standing it on five large insulators.

For short-wave work, usually below 40 m., the inductance of the potentiometer wire is not negligible, and consequently it was decided to use a straight wire of which the inductance was calculable, the current passing through the central wire and back through the screening cylindrical tube.

A radio-frequency oscillator of the series-fed Hartley type with grid condenser and leak gives the best results and will cover all wavelengths down to 5 m. (60 megacycles per sec.). The audio-frequency oscillator consists of a push-pull arrangement with a tuned output circuit in series with the anode feed to the radio-frequency oscillator.

The radio-frequency oscillation is modulated by the screened audio-frequency oscillator and the modulator. By means of a variable coupling between the audio-frequency tuned coupling circuit and the oscillator, and also by shunts across the output transformer of the modulator valve, the modulation percentage may be varied. An inductively-coupled tuned system supplies the screened potentiometer, the current in which is measured by a non-contact thermo-junction. A second junction is inserted inside the oscillator cabin so that the operator can tune the circuits, but no measurements of current are made with this instrument. With the switches in one position the input is normally applied to the amplifier and the negative filament leg is connected to the screens and may be earthed if required, and at the second position the power stage is calibrated with an audio-frequency input by means of a high-resistance potentiometer with the same grid bias under both conditions.

The apparatus is capable of giving an input range of 0.25 to 1,000 mV at any wavelength from 5 to 30,000 m (60 to 0.01 megacycles per sec.) and an output range of 20 to 6,000 mV at any audio-frequency.

The object of the tests was essentially to demonstrate the utility and range of the apparatus, and, although the results show the properties of the different receivers tested, no mathematical analysis of them has been attempted. For the purpose of analytical work, special amplifiers would need

to be built and their constants would require exact measurement. The results, however, demonstrate the types of overall characteristic likely to be obtained from receivers of a similar type to those employed.

The receivers used for the tests were deliberately selected to cover several usual types, and, since the apparatus has been proved satisfactory for measuring the performance of essentially different types, such measurements constitute a reasonable ground for believing that the apparatus can be employed to examine practically any type of receiver.

A 4-valve receiver (200-16,000 *m*) examined had one radio-frequency stage, an anode-current rectifier with resistance-capacity coupling to the first audio-frequency stage, a transformer-coupled audio-frequency stage, and finally a push-pull output stage. The radio-frequency stage is neutrodyned and a tapped secondary winding on the radio-frequency transformer provides retroaction. The rectifier has a choke in series with the anode resistance, and normal aerial and earth connections.

An attempt was made to reconcile the experimental figures for the amplification of the radio-frequency stage and the magnification factor of the input circuit with the theoretical figures obtained by a cursory examination of the circuit. The simplest examination revealed the serious discrepancy between the experimental results and the results obtained by any simple theoretical calculation which neglects the effects due to retroaction and input impedance: not only are both experimental figures far lower than the predicted figures obtained by such a simple analysis, but the form of the curves is different. The departure in form shows that a proportionately higher figure is obtained as the frequency is raised, which is undoubtedly due to retroaction effects at the higher frequencies. It is clear that the input impedance and retroaction effects are very serious, and no useful results would be obtained by a closer examination of the characteristics, as the receiver is one in which no special precautions have been taken to prevent stray retroaction. The results given are of considerable interest, in that they demonstrate the general properties obtained with a typical receiver, but a closer examination would be impossible on account of the numerous unknown quantities involved.

On long waves much greater increase of amplification is possible by the use of retroaction, but the best performance is only slightly better than in the medium wavelength case.

A commercial short-wave receiver (15-60 *m*), employing one stage of radio-frequency amplification, followed by a rectifier valve and, lastly, a normal output valve, was examined, and the general properties noticed were that, owing to capacity shunting effects, the sensitivity falls as the frequency rises in the no-retroaction case, clearly shown in the case of the coil having the range 30-60 m. Another effect of increasing the frequency is to increase the retroaction, resulting in an increase in the amplification, particularly noticeable below 30 m where the sensitivity is maintained. This characteristic agrees with the results obtained on the previous amplifier. In the critical retroaction case the sensitivity increases as the wavelength is reduced, owing to the greater retroaction effect on the shorter waves, but it appears that at wavelengths below 25 m the retroaction condenser cannot be set so critically and a loss of sensitivity takes place. For inputs exceeding 1 mV the amplification is materially reduced. It would appear at first sight that this behaviour is due to amplitude distortion, but it is due to the inability of obtaining so critical an adjustment of the retroaction condenser for the higher inputs. The most striking feature of the results is the very poor amplification of the radio-frequency stage, which never exceeds 2.1 and is only 1 at a wavelength of 28.5 m. It is interesting to note that the maximum coil factor is obtained at the same wavelength as the minimum radio-frequency stage factor for both ranges, and also that the maximum amplification obtained by the use of critical retroaction is obtained at the wavelength corresponding to the minimum radio-frequency stage factor. Since the use of retroaction is responsible for such a large increase in amplification, and since the radio-frequency stage appears to help to such a small extent, one arrives at the conclusion that methods of critical retroaction adjustment are more important than amplification at the high radio-frequency by separate stages. Later experiments have confirmed this view.

A supersonic-heterodyne receiver with frame aerial (50-500 m) was examined and the results are expressed in the paper in such a manner as to be of direct application to the practical use of such receivers. The large difference in sensitivity between the oscillator settings is most marked, particularly at the longer wavelengths. The current in the oscillator was found to rise almost proportionately with the wavelength. With the long-range oscillator coil, 250-800 m, the sensitivity is far greater on the low setting, *i.e.*, with a weaker local heterodyne, and the shape of the curve suggests that the sensitivity falls as the local heterodyne is increased with increase in wavelength. The obvious conclusion on the one hand is that the local heterodyne is too strong; this could be improved by weakening the coupling to the frame aerial. On the other hand, other curves suggest that the local signal is too weak, since the maximum sensitivity always occurs when the oscillator wavelength is high, *i.e.*, the local signal is large. It is well known that there is an optimum intensity for the local oscillation, and since no control is provided, it is not surprising that this optimum has not been obtained in this particular case. The two conditions, above and below this optimum, represented by the long and short oscillator coils illustrate the utility of such characteristics as a guide to improving the design of a receiver. The difference between the sensitivity characteristics for the high and low oscillator settings is small at the short wavelengths owing to the small difference between the condenser settings and consequently the small difference in the strength of the local signal, whereas at higher wavelengths the difference is very large.

From a perusal of the foregoing examples of the properties of receivers, it is apparent that the overall properties of any receiver can be expressed in terms of three characteristics:—

(*a*) The input voltage required at a definite modulation percentage to produce a definite standard output signal at all wavelengths within the designed range; (*b*) the sensitivity variation in the neighbourhood of certain fixed wavelengths; this gives the selectivity of the receiver; (*c*) the output variation with constant input and modulation percentage, but variable modulation frequency; this gives the frequency distorting properties of the audio-frequency stages.

These three characteristics completely define the overall properties and, by means of them, the utility of a particular receiver can be obtained for any particular function.

To determine the range of a receiver with respect to a particular transmitting station, two characteristics are required: (i) the field-intensity characteristic of the transmitter expressed in the form of contour lines on a map; (ii) the field-intensity/output characteristic of the receiver.

The limiting range of any receiver is easily obtained by this means, and the range for medium loud-speaker reception can also be obtained in a similar manner. In the case of an open antenna the latter characteristic involves a knowledge of its effective height. In view of the accuracy with which field-intensity measurements can now be made, and the consequent knowledge of the field distribution from a transmitting station, the author feels that if similar field-intensity/output characteristics were forthcoming for receivers, a considerable step would be taken towards more scientific classification of types, and the immediate result of such a classification would be to improve the design of radio receivers.

In a somewhat similar manner the classification of receivers into various selectivity categories would help towards the correct selection of a receiver for a particular purpose. The selective properties of a receiver could be expressed as a figure which could be appended to the previous characteristic at the different wavelengths covered by that characteristic. Such a simple system would simplify the final statement of performance and would, in fact, enable the radio-frequency properties to be expressed in the form of a single curve.

The audio-frequency properties of a receiver have received considerable attention, chiefly because such results are comparatively simple to obtain, and undoubtedly the progress in the design of audio-frequency amplifiers has followed measurements which have revealed the faults in the older types of amplifier. By means of an overall measurement, however, this characteristic would form a part of the tests and would take its place with the complete statement of the performance.

Electro-metallurgical Progress in Canada.

The development in large volume of electrical power in the neighbourhood of Sault Ste. Marie is likely to bring in its train important new electro-metallurgical industries at the Algoma Steel Corporation's plant and elsewhere in the vicinity. The Great Lakes Power Company has completed a h.p. transmission line from its plant at High Falls on the Michipicoten River, and from this and other plants in the neighbourhood about 100,000 h.p. will be available for use by industries to be established at Sault Ste. Marie. Much of this will be needed by existing industries, and a considerable volume of power will be called for at the New Helen mine and sintering plant, when it is put into operation. For a number of years, however, there will be available cheap power for electro-metallurgical processes. In this connection, it is of interest to record that the Algoma Steel Corporation is on the point of completing a plant for the manufacture of ferro-silicon, which will supply the entire requirements of that concern, and may also have a surplus for sale to other Canadian steel makers. Hitherto all of this essential alloy for the steel industry has been imported. A second unit of this ferro-alloy plant is to be established for the production of calcium molybdate, which has now largely displaced ferro-molybdenum in the manufacture of molybdenum steels. The molybdenite for this purpose will be brought from producers in Eastern Canada, thus affording a ready and reliable market for molybdenite concentrates, in contrast to the export market which has proved to be unreliable, and has not encouraged the investment of capital in the survey of properties and development of mining operations.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this section.

A Liquid-storage Gauge.

The "Nivex" gauge, a product of NIVEX GAUGE, LTD., Tipping Street, Ardwick, Manchester, introduces, it is claimed, an inexpensive method of ascertaining at a glance the exact quantity of liquid stored in a tank or other container. The quantity of liquid is recorded in gallons or fractions of a gallon, on a dial which can be placed in any convenient position at any distance from the tank. The principle of the system is that the pressure required to expel the liquid in

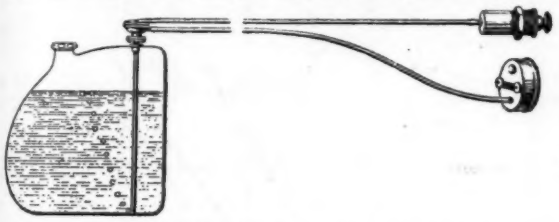


Fig. 1.—Principle of "Nivex" Gauge.

a tube inserted in a vessel is proportionate to the depth of liquid in the tube. Fig. 1 shows a simple form of the apparatus. When the plunger is pulled and released, a spring operates a piston, causing compressed air to enter the pipe line. This forces out the liquid which has arisen in the tank tube, and at the moment the bubbles escape, the pressure required becomes stabilised, and is indicated by the gauge proper at the required position.

A New Switch-Fuse.

MIDLAND ELECTRIC MANUFACTURING CO., LTD., Barford Street, Birmingham, send us particulars of a new range of switch-fuses, "Memrex-Senior." These new switch units are of the "Memrex" pattern, but are provided with top and bottom cable entries. Knockouts are provided, making the switch suitable for almost every conceivable position and

Fig. 2.—The "Memrex-Senior."

method of wiring. The case is weatherproof and lined with white insulating enamel. This new series of switches complies fully with B.E.S.A. Specification 124, and is licensed to be so marked. Interlocking is provided between the switch handle and the door of the case, so that the switch cannot be "on" when the live parts are exposed. Fig. 2 shows a "Memrex-Senior" with the door open.

A New Industrial Lighting Fitting.

The "Labor" industrial lighting fitting, fig. 3, a recent introduction of BRITISH B.A.G., LTD., 23, Farringdon Avenue, E.C.4, is supplied with a B.A.G. diffuser in the form of a glass bowl suspended by three chains from a metal reflector. The bowl is made of semi-opaque diffusing glassware, and there is a silver mirror deposited on the inner (upper) surface of the bottom of the bowl to reflect more light to the white enamelled under part of the metal reflector. A circular opening in the centre of the bottom of the diffuser allows a

Fig. 3.—The "Labor" Industrial Lighting Fitting.

certain quantity of light to fall vertically direct on to the object which it is desired to illuminate. This fitting has been satisfactorily installed in the Ormskirk Hospital for use over the operating table; if it is properly focused, there is an almost complete dispersal of all shadows otherwise cast by the hands of the surgeon and his assistants. Another special use for this fitting is in connection with the cleaning of motor cars. It allows faint smears and smudges on the paintwork to be clearly seen, which, the makers claim, is not the case with an ordinary industrial unit not fitted with a diffuser. An additional advantage of this fitting is that it can very easily be converted into the ordinary type by detaching the diffuser from the chains.

A New Wire Stripper.

The "E-Z" wire stripper, fig. 4, a product of Messrs. J. B. HYDE & CO., LTD., Broadheath, near Manchester, which should prove particularly useful in the wiring trades, has a triplicate action—clamping the wire, cutting the insulation, and stripping the insulation—all automatically timed, as the

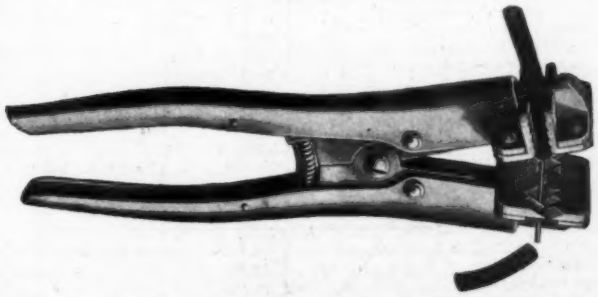


Fig. 4.—The "E-Z" Wire Stripper.

result of one squeeze of the handles. The device is always ready for immediate use, and it requires no setting. The tool protects both the operator's hands and the wire. The cutting edges are shielded, and blind centres of the V notches on the blades prevent, it is claimed, cutting or scarring of the wire. There are two standard models, one for dealing with wires of from 12 to 22 gauges, and the other for dealing with from 10 to 18 gauge wires. The tool is about the size of a large pair of electrician's pliers.

Motor Users and the Frequency Change.

The advantages of installing single-frequency motors, with a view to their subsequent replacement, rather than dual-frequency motors.

By T. H. WINDIBANK.

(*Abstract of a paper read before the* BIRMINGHAM ELECTRIC CLUB.)

PREPARATIONS to minimise the disturbance which will follow a change of frequency must be made with due regard to the fact that the details of the change are transient, but the effects are permanent. The quality of service will be affected permanently by machines which are installed now, both before and after the actual change-over of frequency takes place.

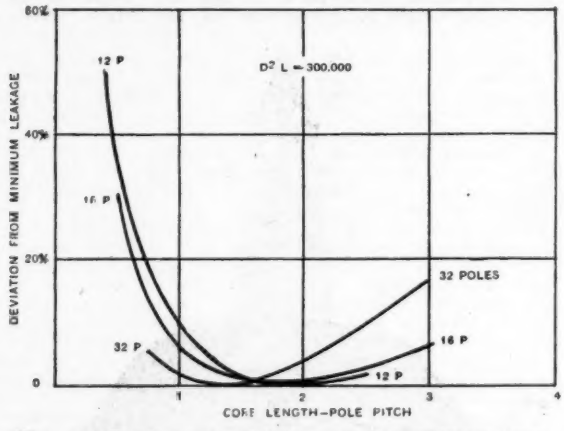


Fig. 1.—Leakage in Relation to Core Dimensions.

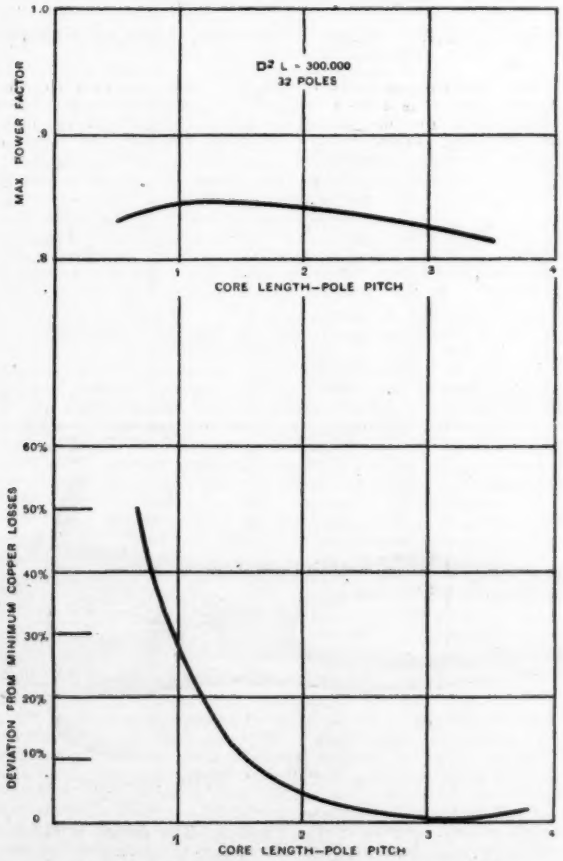


Fig. 2.—Influence of Core Dimensions on Power Factor and Copper Losses.

Obviously the interests of the user must be paramount. The motor user has the choice of installing either a machine which attempts to fulfil two sets of conditions of opposing tendency, or two machines, one for each frequency, each designed for its own particular condition of service. A study of the subject will show that even tolerable conditions with one machine are obtainable only by expenditure on redundant material, and that the performance of the dual-purpose machine must fall considerably behind that obtainable with single-purpose designs. The most aggravated condition of the evils of a compromise will appear after the change takes place, in so far as performance is concerned; the penalty is therefore deferred, but not diminished.

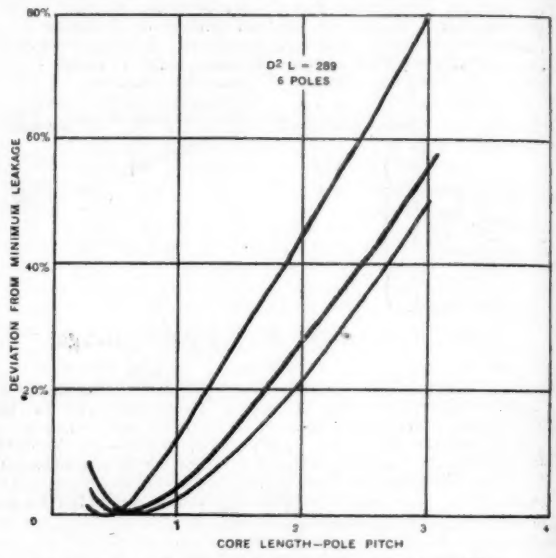


Fig. 3.—Influence of Number of Rotor Slots.

Although design is a compromise between various factors, it must give to each factor its due proportion and thus arrive at a successful compromise for a given set of circumstances. Thereafter, the alteration of one factor may vary one feature or performance for better or worse, but—if the design was the best obtainable—the general level of performance must be lower. One of the most important influences

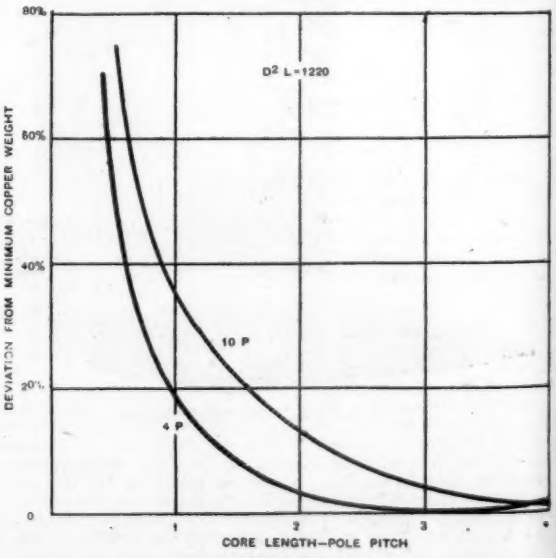


Fig. 4.—Core dimensions for Minimum Weight of Copper.

on performance and cost in the induction motor is the choice of the ratio between the rotor diameter and core length (or core length and pole pitch). The proportions which give for any one rating the best power factor, the lowest copper losses, the lowest iron losses, and highest overload capacity are calculable by methods which are above contention. Deviations from the best ratio core length/pole pitch are more or less critical in the effect on performance or cost, but the dual-frequency machine demands a variation of 100 per cent. and should have a performance comparable with that of a single-frequency motor.

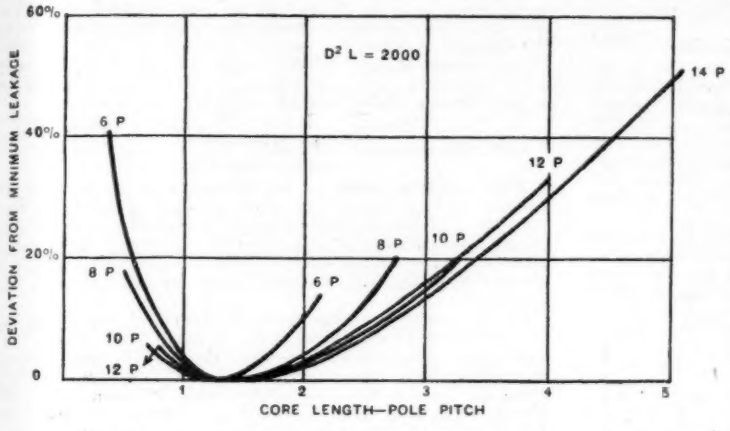


Fig. 5.—Leakage with Minimum Weight of Copper at Two Frequencies.

Considering first the leakage coefficient, which is practically fixed as soon as the punchings, core length, and number of poles are settled, all the characteristics of the motor are improved by its reduction. From a study of the circle diagrams for a typical small six-pole machine, it is shown that if we could decrease the leakage coefficient by one-third, keeping the magnetising current the same, we could increase the full-load power factor from 72 to 75 per cent., the maximum power factor from 75 to 85 per cent., and the maximum torque from 50 per cent. overload to 125 per cent. overload. The deviation from minimum leakage with varying core proportions is shown in fig. 1. It may be advanced that were leakage the only consideration, a value of 1.0 for core length/pole pitch at 25 cycles would automatically give a value of 2.0 at 50 cycles, and that the deviation from minimum in either case would not be more than 10 per cent. Unfortunately, considerations of efficiency, copper losses, and copper weight impose other values which drive one or other ratio to a steep portion of the curve.

Fig. 3 shows for a small machine the influence of varying numbers of rotor slots and their appropriate bars, all other factors remaining the same. Higher values of leakage are obtained with fewer slots and wider bars. The dual-frequency machine, restricted to one diameter of rotor for both frequencies, will not permit the same choice of a large number of slots as is obtainable with two single-frequency motors.

Considering next the choice of dimensions for the minimum copper weight, it is shown by fig. 4 that a choice of ratio of 2.25 for core length/pole pitch at 25 periods, giving 4.5 at 50 periods, would give approximately a minimum copper weight in both cases; but reference to fig. 5 shows that extremely high values of leakage are the result of this choice, especially on 50 periods.

Fig. 2 shows for a large design the opposing influence of power factor and copper losses, as affected by the choice of core proportions. It is clearly possible to choose one ratio core length/pole pitch which will give a good power factor and copper losses not far from the minimum, but the dual-frequency machine is at a serious disadvantage in that two such ratios must be chosen.

The effect of high leakage on overload capacity is shown in fig. 7.

While it is true that core proportions are not the only influences on leakage, on the losses and on the overload capacity, yet it is shown that they are to be the dominating influences, and that there is a critical best core proportion for a given number of poles.

The curves reproduced were calculated from single-winding machines, and are taken from an authoritative paper read before the American I.E.E.

The superimposed effect of the dual-frequency winding design alters the leakage, due to the employment of a shorter-pitch winding on the 25 cycle supply and a longer pitch on 50 cycles. This would show an improvement in one portion of the leakage on 25 cycles, but an increase in that portion for 50 cycles, that is, the worst case is made more unfavourable still.

Secondly, in both sets of connections of a dual-frequency winding certain conductors are ineffective, because conductors in the same slots are carrying currents of opposite sign, and therefore, the M.M.F. is considerably lower than that of the full-pitch winding of a single-frequency motor. This is shown in fig. 6 for a 24 slot (8 pole, 50 periods or 4 pole 25 periods) winding. In this case for a given M.M.F. about 15 per cent. more magnetising current must be drawn from the line on 50 periods with a reduction of power factor. The portions of the windings doing no useful work are adding to the losses and leakage; further, due to the irregular flux variations caused by cancellation of the M.M.F. in certain slots the dual-frequency motor will tend to be noisy, particularly on 50 cycles.

On dual-frequency squirrel-cage machines a reduction in starting torque accompanies the change from 25 to 50 cycles. When operating at 25 cycles with few poles, the path for the current in the end ring is long, the end-ring and rotor resistances are high, and the starting torque is normal. When the number of poles is doubled, the effective length of circuit in the end ring and the resistance is halved, and the starting torque is much reduced. It is not uncommon for dual-frequency machines to start satisfactorily on 25 cycles and fail to start against normal load on 50 cycles. If a high-torque machine is used the variation in rotor resistance necessitates a much larger machine than is otherwise necessary; the alternative is a rotor design which gives high slip, and consequently high losses on 25 cycles. Variation of rotor resistance also causes dual-frequency machines to run somewhat faster on 50 cycles.

The problem and inconvenience of changing a motor when the frequency is changed is not so great that the performance of the motor up to and after the change may be neglected. A machine can be produced which will run moderately well on 25 or 50 cycles, but not at the low cost of high efficiency of the single-frequency motor.

The full high price for the dual-frequency machine must be paid at the time of installation on 25 cycles, and idle capital is therefore locked up in the machine. For this high price a non-standard motor is obtained, probably with long delivery. Some makers recommend that the user should calculate his starting torque on a 50-cycle basis, offer 66 per cent. full-load torque on 50 cycles and 33⅓ per cent. on 25 cycles, and recommend the use of auto-transformer starters in all cases.

The alternative to the use of such machines is the installation of a standard high-efficiency single-frequency motor

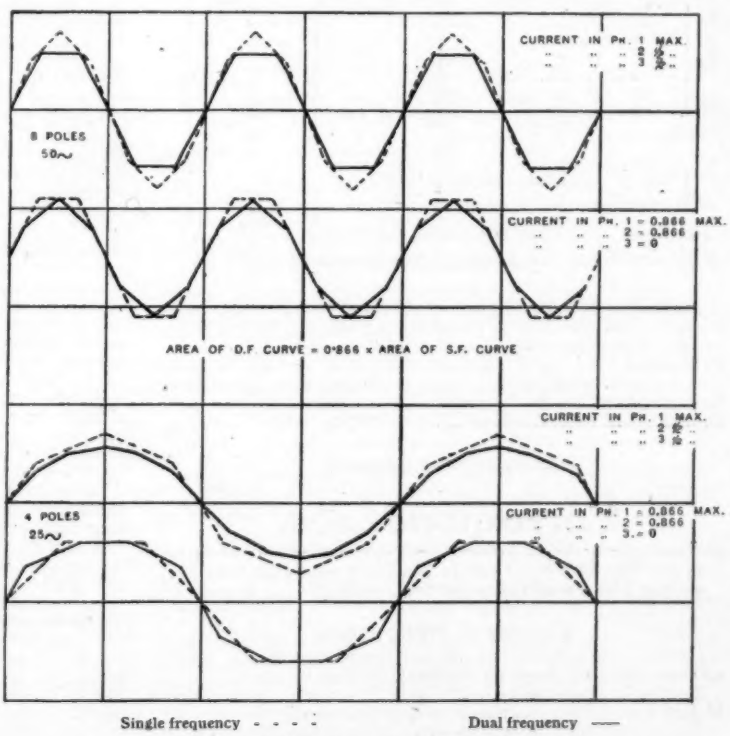

CURRENT IN PH. 1 MAX.
8 POLES
50~
CURRENT IN PH. 1 = 0.866 MAX.
2 = 0.866
3 = 0
AREA OF D.F. CURVE = 0·866 × AREA OF S.F. CURVE
CURRENT IN PH. 1 MAX.
4 POLES
25~
CURRENT IN PH. 1 = 0.866 MAX.
2 = 0.866
3 = 0
Single frequency - - - -
Dual frequency ——

Fig. 6.—Magnetomotive Force Curves.

bought at a competitive price. At the time of installation a firm quotation can be obtained from at least one manufacturer for exchanging a standard 50-cycle machine at any time, and, if necessary, a guarantee can be given that a machine with the same physical characteristics will be supplied. This machine, in the case in point, is further guaranteed for a fresh period in accordance with the standard seven-year guarantee. With this alternative, depreciation at the time of change-over is wiped out, a new and fully guaranteed machine is obtained, and the machine avoids any possibility of starting troubles or low efficiency.

By comparing market prices for a dual-frequency machine and for a single frequency machine plus the cost of an exchange machine, it can be shown that the second choice is by far the cheaper, irrespective of the advantages it offers. For instance, a dual frequency machine, which with interest on capital outlay will have cost £118 after three years, compares with a single frequency machine costing—including the exchange machine—£91. The dual-frequency machine will be three years old, whereas the single-frequency, 50-cycle machine will be new.

The actual change-over is very little simpler in the case of the dual-frequency machine. The connections must be altered, the fuses or overload settings adjusted, and the speed checked. It is most probable that advantage will be taken

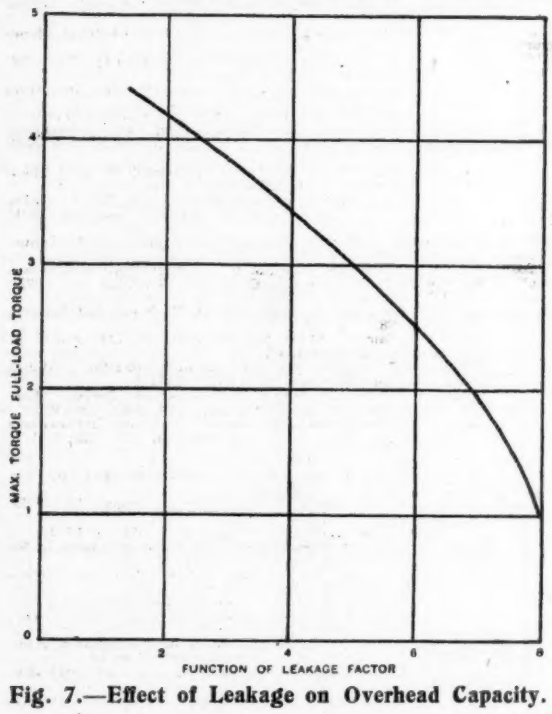


Fig. 7.—Effect of Leakage on Overhead Capacity.

of the change to dismantle the motor for cleaning. The single frequency machine has to be set on the existing foundations, connected exactly as the machine it displaces and the fuses or trips set. For the problematical saving of an hour or two, with a dual machine the whole performance of the motor throughout its life will be indifferent, and this indifferent performance will be obtained at a higher capital cost.

Correspondence.

Correspondents should forward their communications as early as possible. No letter can be published unless we have the writer's name and address in our possession.

Thawing of Water Pipes.

I have been interested in the correspondence on the above subject which has recently appeared in your columns.

The trouble referred to by "J.W.B." is not a common one in this country and is difficult to guard against.

The usual points of trouble are: (1) near the stop cock at the point of entry to the house, due to the restricted waterway at that point and the increase in metal; (2) at the ball valves on cisterns, for the same reasons; (3) where pipes pass over or beside windows or doors.

As a previous correspondent pointed out the thing to do is to prevent the freezing from occurring.

The best, cheapest, and simplest means of doing so is a small gadget, known as the "Stop! O Freeze." It consists of a metal shoe carrying an end bracket, and a covering hood. A lamp is fixed in the bracket and covered by the hood, while the shoe is screwed to the skirting by ordinary wood screws, or if the pipe is not attached to a skirting the shoe is held to it by means of a couple of little U bolts.

A 40-watt lamp is sufficient for all ordinary situations, but it will take larger ones.

Besides being easily fixed, it is perfectly safe as the shoe is in contact with the earthed water pipe, so that there is no risk of shock, should one wish to remove the lamp, and, moreover, the heat, although sufficient for the purpose, is not great enough to melt the pipe should it become empty of water due to a burst elsewhere at a lower level.

All that needs to be done is to fix the heater permanently in position, and, on frosty nights, put a spare lamp in, if one is not left in, and take the flex carrying an adaptor to the nearest lampholder.

It is being placed on the market shortly, and if any of your readers would like advance information, I shall be pleased to put them in touch with the patentee.

P. Ward.

Low Fell, *January 13th*, 1930.

With reference to the several letters in recent issues under the above heading, there is no novelty in thawing electrically, and surely any English transformer maker can supply a transformer for the job. As a maker, I can say that this is a very ordinary simple piece of apparatus. There is no money in the job, as freeze-ups are so infrequent in this country.

By the way, the pipe does not usually burst when the water freezes at only one place, or even when it starts at only one place and freezes from there progressively along the pipe. The burst usually occurs between two portions that have, for a time, unfrozen water between them. As the freezing progresses the ensuing expansion, as the water forms into ice, can thus only take place between the two frozen portions, and, as this takes place progressively from these points, the room for expansion is progressively decreased, resulting in the swelling that will be noticed, which is many times the amount attributable to the limited expansion of the ice immediately within the swollen portion where the burst usually occurs.

Therefore, if the pipe is thawed soon after freezing or before this progressive action has taken place, a burst in fully 99 per cent. of cases can be avoided.

Another point: if there is a hot water tap somewhere near the point of entry of the main supply into the house, simply feed current between a point as near entry as possible and the hot water tap. The current then has to travel right up to the cistern, and back through the hot water system, to the transformer, and is pretty safe to find the spot without wasting time looking for cold corners. There must, of course, be a metallic connection between the hot and cold water systems, which is usually already there through the lead lining of the cistern. When frozen up at home during the very cold spell we had about two years ago, I think, I attached the two secondary terminals of the transformer to the hot and cold water taps, respectively, in the scullery, where the water supply comes in, and was thawed out in less time than it took to walk upstairs to see if there was anything visible or audible happening, and back to the scullery. The length of pipe would be about 200 ft. Current, 150 amps. at 12 volts. The stop tap can be used for connection if so doing includes the frozen portion in circuit.

W. E. Burnand.

Sheffield, *January 13th*, 1930.

Cookers—and Cooking.

I should like, if you will allow me, to reply to the points raised by your correspondents regarding the article on the above-named subject.

One quite appreciates why Mr. Williams does not favour a "high" oven. I agree with him that the lower shelves of such an oven are nearer the ground than one would like but that, though important, is not so important as the obtaining of good results, and my experience shows that these are best obtained with a side-heated high oven.

Some of his points are really matters of layout and assembly and I may, if you are agreeable, try to deal with that aspect in a further article.

It may be that the "best" cooks work on temperature, but we have yet to cater for the others as well, and I have yet to find the perfect oven thermometer.

I am familiar with the enclosed radiant type of plate to which he refers. There are three of them to my knowledge, and they have possibilities.

I do not agree with grilling in the oven. Canadian housewives may do it, but I do not think that English ones will. It has the one advantage that a larger grill can be provided, but it has many disadvantages, including the introduction of top and bottom heat in the oven.

The use of the word "shoddy" in your editorial comment, and in Mr. McKenna's letter, implies that poor material and bad workmanship are the prime causes of poor cookers. There are, however, cookers of excellent construction, but of bad layout and assembly, which are still poor cookers.

I agree that very good results can be obtained, under selected conditions, with solid plates, but these conditions are not found in the average house. I also agree that where solid plates are used, suitable pans *ought* to be found, but the fact remains that they are not, and that it is a very difficult matter to persuade the consumer to provide them. We have to face the facts as they are and not as we would like them to be. If one plate one pan were the rule

Mr. Williams's case for the round plate would be a good one, but we often find three pans to the plate, sometimes more.

I agree, again, that the bulk of the development in recent years has been with the solid plate, but my contention is that more attention should be paid to the other types, such as the enclosed but radiant plate mentioned by Mr. Williams. It is rather difficult to put the various plates into their proper places in the three categories, open, enclosed, and solid, as they overlap somewhat.

The plate mentioned by Mr. Howard, is one of those which I had in mind when writing the last three lines on page 1135 and the last nine lines of the first paragraph on page 1136.

A Consumers' Engineer.

January 13th, 1930.

Risum Teneatis?

Mr. W. J. Minton in your issue of January 10th says that he has looked in vain through some issues of the *Farmer and Stock-breeder* for advertisements of apparatus for use with power from mains. May I say that had he looked in the issue of December 9th he would have seen the attached advertisement of the "Blue Ribbon" electric milker which appears at regular intervals.

The "Electrolux" advertisement, to which he refers as being for use with an oil burner, was deliberately inserted by its makers, because they assumed that, while their electric and gas models appealed most to townspeople, the majority of our readers are still without electricity supplies. The results of the 1929 series seem to prove the correctness of that assumption because they have now renewed the contract for 1930.

I gather, however, that Mr. Minton's amusement is not so much with the policy of the apparatus manufacturers, as with that of the managements of the rural electricity supply authorities. I am not qualified to deal with this point, except that I do know that some of our readers have the mains running across their farms, and even then the charge made for connection with their buildings is so high as to make the use of electricity not worth their while.

W. J. Casey,
Joint Advertisement Manager,
"FARMER AND STOCK-BREEDER."

London, W.C.2. *January 14th*, 1930.

The All-electric House.

I have read with great interest the discussion on the above subject which has been taking place in your columns during the past few weeks. I suppose I am mainly to blame for the warfare which has been so stoutly waged by your correspondents. In a recent article of mine, entitled "My Electric House" (ELECTRICAL REVIEW, August 16th, 1929, page 269) I put forward the view "that very few electrical men practise what they preach as regards electricity in the home," and I trusted that my contribution would "stimulate others to prepare reports on similar lines, which could be used for propaganda purposes as examples of actual installations."

It is, therefore, very refreshing indeed to see electrical engineers coming out into the open at last to broadcast their faith in domestic electrification in their own homes, backing this up with facts and figures. In this connection I would say "Well done, Mr. Wardale," whose view and remarks have been most heartening and very closely resemble my own. I would particularly commend to your readers' notice the last paragraph of Mr. Wardale's letter in your current issue, in which the case for electricity in the home has been summed up in a most concise and valuable manner.

Now then, you other electrical engineers, keep the electrical flag flying in your homes.

Reg. H. Rawll, A.M.Inst.C.E., A.M.I.Mech.E.

Birmingham, *January 18th*, 1930.

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings taken.

1928.

18,052. "Arrangements for increasing the sensitiveness of alternating-current instruments." Siemens Schuckertwerke Akt. Ges. July 5th, 1927. (303,387.)

18,234. "Apparatus for the transformation of electric alternating currents into direct currents, and *vice versâ*." M. Urbinati. June 23rd, 1927. (292,617.)

20,875. "Systems for reducing the disturbances caused by apparatus capable of producing high-frequency interference with radio-receiving apparatus." O. Gerhardt. July 18th, 1928. (323,244.)

21,032. "Apparatus for visibly indicating navigation lights and sounds." H. Barnes. July 20th, 1928. (323,182.)

21,308. "Wireless message transmission." O. Tants. July 23rd, 1928. (323,245.)

23,873. "Electric sign controllers." W. Stafford. August 20th, 1928. (323,306.)

23,943. "Distant-control plant utilising electric resonance relays." Siemens-Schuckertwerke Akt. Ges. and A. Callsen. August 20th, 1928. (323,184.)

24,253. "Electrical precipitation of dust from gases." General Electric Co., Ltd., and F. Forrest. August 23rd, 1928. (323,186.)

27,122. "Electric imitation fires." H. H. Berry. September 21st, 1928. (Cognate application 2,519/29.) (323,190.)

27,130. "Electrodes for electric batteries, electrolytic cells, and the like." L. A. Levy and Almeida Accumulators, Ltd. September 21st, 1928. (323,192.)

27,154. "Electromagnetic apparatus for the observation and correction of travel of aerial and marine craft." E. Vion. July 2nd, 1928. (314,786.)

27,157. "Electric traction control systems." A. D. Ferguson and Associated Electrical Industries, Ltd. September 21st, 1928. (323,194.)

27,193. "Electric furnaces." Heraeus Vacuumschmelze Akt. Ges., and H. Hiemenz. January 23rd, 1928. (304,646.)

27,199. "Tuning devices for oscillatory circuits." A. E. Bowyer-Lowe. September 21st, 1928. (323,255.)

27,277. "Microphones." H. Green and Celebritone, Ltd. September 22nd, 1928. (323,200.)

27,326. "Magnetic materials." W. E. Beatty (Bell Telephone Laboratories, Inc.). September 24th, 1928. (323,222.)

27,503. "Electric batteries." Dr. M. Wilderman. September 25th, 1928. (323,228.)

27,534. "Telephone systems." Associated Telephone & Telegraph Co. September 26th, 1927. (297,747.)

27,646. "Telephone receivers." L. Mellersh-Jackson. (Telefonaktiebolaget L.M. Ericsson.) September 26th, 1928. (Convention date not granted.) (296,078.)

27,756. "Wireless signalling apparatus." G. Marconi. September 27th, 1928. (323,237.)

27,874. "Loud-speakers." C. J. Nesbitt-Dufort and O. & S. Oilless Bearing Co., Ltd. September 28th, 1928. (323,264.)

27,876. "Wireless receiving apparatus." C. J. Nesbitt-Dufort and O. & S. Oilless Bearing Co., Ltd. (323,265.)

27,953. "Electrical ceiling roses, lampholders, suspension switches, couplings, and the like." J. A. Crabtree and B. G. Harrison. September 29th, 1928. (323,268.)

28,278. "Telephone systems." Associated Telephone & Telegraph Co. October 8th, 1927. (298,474.)

29,309. "Prepayment electricity and other meters." Chamberlain & Hookham, Ltd., and S. James. October 11th, 1928. (323,285.)

30,005. "Electric melting furnaces." Electric Furnace Co., Ltd., and D. F. Campbell. October 17th, 1928. (323,291.)

30,129. "Electrodes for use in dental surgery." H. Laborenz. October 18th, 1928. (323,292.)

31,807. "Electric current-limiting reactors." Conduit Electrical Manufacturing Corporation. December 31st, 1927. (303,349.)

32,221. "Thermionic valve circuits." J. Dieux. January 7th, 1928. (303,741.)

33,083. "Thermo-electric switches." Siemens-Schuckertwerke Akt. Ges., R. J. Pick and P. Stern. November 12th, 1928. (323,311.)

33,648. "Means for operating or controlling the ignition advance in internal-combustion engines." S. J. Ziembinski. November 18th, 1927. (300,653.)

34,529. "Railway signalling systems." A. Wolf. November 23rd, 1928. (323,329.)

34,573. "Control systems for electric motors." Associated Electrical Industries, Ltd. (November 30th, 1927. (301,464.)

34,758. "Aerials for transmitting wireless signals." S. G. S. Dicker (Naamlooze Vennootschap Philips' Gloelampenfabrieken). November 26th, 1928. (323,331.)

34,976. "Plug-and-socket electric couplings." L. Seguin and A. Seguin. December 2nd, 1927. (301,505.)

35,260. "Earth-fault protective arrangements for alternating-current generators." International General Electric Co., Inc. November 29th, 1927. (Addition to 291,721.) (301,435.)

36,024. "Lightning or surge absorbers." E. D. T. Norris and Ferranti, Ltd. December 6th, 1928. (323,342.)

36,296. "Electric insulators." Micanite & Insulators Co., Ltd., and G. E. Haefely. December 8th, 1928. (323,343.)

38,195. "Incandescent electric lamps and mountings therefor." British Thomson-Houston Co., Ltd. December 28th, 1927. (303,114.)

38,264. "Cam-operated electric contactor switches and like devices." English Electric Co., Ltd., and C. T. Scarf. December 28th, 1928. (333,363.)

38,428. "Cathode for electron-discharge devices." Soc. des Etablissements Industriels de E. C. et de A. Grammont. December 31st, 1927. (303,369.)

1929.

272. "Electric transformers." A. W. G. Tucker and Ferranti, Ltd. January 3rd, 1929. (323,370.)

2,018. "Electric immersion heaters." F. A. Kirsten. January 21st, 1929. (323,385.)

2,040. "Magnetos." Wico Electric Co. August 31st, 1928. (318,221.)

2,638. "Electric lighter for pipes, cigars, and cigarettes, specially for motor-cars. K. Manger. January 27th, 1928. (304,790.)

4,579. "Energy supply systems for thermionic valves." Marconi's Wireless Telegraph Co., Ltd. February 11th, 1928. (305,944.)

5,044. "Apparatus for the supervision of electric power-distributing systems." L. Mellersh-Jackson (Siemens & Halske Akt. Ges.). February 14th, 1929. (323,404.)

5,358. "Device for determining the temperature of the oil contained in oil-immersed transformers." E. Fries. December 5th, 1928. (323,408.)

5,406. "Electric switch." O. Schneider and A. Weißenbach. February 18th, 1929. (323,410.)

7,024. "Cable eyes or sockets for electric cables." E. Scharpenberg. March 4th, 1929. (323,420.)

7,513. "Electron discharge tubes or thermionic valves." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. December 4th, 1928. (323,424.)

8,112. "Submarine cables." Felten & Guilleaume Carlswerk Akt.-Ges. April 11th, 1928. (309,486.)

9,056. "Method of and means for distinguishing electric cables." E. L. Wildy and London Electric Wire Co. & Smiths, Ltd. March 20th, 1929. (323,431.)

9,317. "Telephone systems." Associated Telephone & Telegraph Co. October 8th, 1927. (Divided application on 298,474.) (306,366.)

12,876. "Clamps for electric conductors." R. Schultz. April 25th, 1929. (323,440.)

14,844. "Luminous electric discharge tubes." General Electric Co., Ltd. July 17th, 1928. (315,757.)

15,375. "Dynamo-electric machines." Associated Electrical Industries, Ltd. May 17th, 1928. (311,819.)

28,815. "Electric furnaces." Heraeus Vacuumschmelze Akt.-Ges. September 21st, 1928. (Divided application on 304,646.) (323,271.)

Trade Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from January 15th:—

Dubilier (lettering and design). No. 502,492. Class 8. Electric batteries (not for medical purposes).—Dubilier Condenser Co. (1925), Ltd., Victoria Road, North Acton, W.3.

Sabur. No. 503,845. Class 8. Accumulators and batteries for use in connection with radio-telephony.—J. A. Isaacson, trading as the District Gramophone and Wireless Co., 323, Old Kent Road, and 107, Tower Bridge Road, S.E.1.

Lewbestite. No. 507,687. All goods in Class 8. No. 507,688. All goods in Class 40. No. 507,689. Class 50. Electrical fittings manufactured from animal and vegetable substances, wire covered with asbestos and wire covered with a composition in which bitumen predominates.—London Electric Wire Co. and Smiths, Ltd., 7, Playhouse Yard, Golden Lane, E.C.1.

Recordion (lettering and design). No. 507,760. Class 8. Instruments consisting of a combination of a gramophone with a radio receiving set.—Radio Recordion, Ltd., 16, Lisle Street, Newcastle-on-Tyne.

Inc, No. 507,779; Invincible, No. 507,780; and Sundar, No. 507,781. Class 8. Instruments and apparatus for use in connection with radio-telephony.—Gas Light Fittings Co., Ltd., 322, Walworth Road, S.E.17.

Phililite. No. 505,341. Class 13. Electric lamps and electric light fittings.—Naamlooze Vennootschap Philips' Gloeilampenfabrieken, Holland. (British representatives: Boult, Wade & Tennant, 112, Hatton Garden, E.C.1.)

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

BARNSLEY.—Store, Wellington Street; Co-operative Society, Ltd. Store, glass works, Barbro' Hill Road; Redfern Bros.

BLACKPOOL.—Elementary school; Dr. Ikin, director of education.

BLYTH.—Central school and extension of Princess Louise Road school; secretary to the E.C.

BOLTON.—Senior school, Great Lever, for the E.C. Labour exchange, Great Moor Street; H.M. Office of Works.

BOOTLE.—Housing scheme (247), Northfield Road; borough engineer, Town Hall (deposit £2 2s.).

BRADFORD.—Telephone exchange, Leach Square; H.M. Office of Works.

BRIERLEY HILL.—Development of Silver End estate, Brettell Lane; George King Harrison, Ltd.

BRISTOL.—Housing scheme (204), Bedminster, for the T.C.; L. S. McKenzie, city engineer (returnable deposit of £1). Buildings, Broad Quay (£50,000); Co-operative Wholesale Society, Ltd.

CAMPDEN.—Housing scheme (54), for the R.D.C.; surveyor.

CHELMSFORD.—Telephone exchange, for H.M. Office of Works, King Charles Street, London, S.W.

CHERITON (FOLKESTONE).—Electric lighting installation, St. Martin's Church; vicar.

CHESLYN HAY (STAFFS.).—United Methodist church and school, Hilton Park; trustees.

CHESTERFIELD.—Boys' school (£18,666); mixed school, Tapton House; education committee.

CIPPENHAM (SLOUGH).—Development of estate for 2,000 houses, with electrical work, for F. Smith.

CONGLETON.—Housing scheme (78), for the T.C.; borough surveyor.

DERBY.—Additional housing scheme (250), Alvaston, for the T.C.; borough surveyor.

DORCHESTER.—Housing schemes, Damars Road and Cambridge Road; borough engineer. Brewery bottling stores, for Eldridge, Pope & Co.; Crickmay & Sons, architects, Weymouth (returnable deposit of £2 2s.).

DORKING.—Post office (£25,000 to £30,000), for H.M. Office of Works, King Charles Street, London, S.W.

DROGHEDA.—Housing scheme (70); borough surveyor.

DUDLEY.—Church, Priory estate; Free Church Council.

ELLAND.—Sewage disposal works (£8,500); surveyor to U.D.C.

ETON.—Rebuilding bank, High Street, for Barclay's Bank, Ltd., London.

GILLINGHAM (KENT).—Additional 64 houses, Rainham, for the T.C.; borough surveyor.

HASTINGS.—Restaurant, 23, Robertson Street, for F. J. Harris; Callow & Callow, architects.

HECKMONDWIKE.—Re-erection of the Olympia Ballrooms, for J. & H. Rhodes.

HUDDERSFIELD.—Extensions and reinstatement of schools at Rashcliffe, for the C.O.E. Denomination; Abbey and Hanson, architects, 11, Cloth Hall Street.

HULL.—Four shops, Inglemire Lane; A. I. Windross and Partners, Ltd.

IRISH FREE STATE (BIRR, KING'S CO.).—Houses (20), for the U.D.C.; Higginbotham & Stafford, architects, 3, Clare Street, Dublin.

KENDAL.—Housing scheme (60), for the T.C.; F. W. Oxberry, borough surveyor (returnable deposit of £2 2s.).

KINGSWINFORD.—School (480 places), Audnam, for Staffs. E.C.; E. Joy, clerk, Stafford.

LEOMINSTER.—Housing scheme (90), for the T.C.; borough surveyor.

LINCOLN.—Swimming and slipper baths for the City Council (£42,950).

LIVERPOOL.—Baths (£150,000); city land steward and surveyor.

LONDON (ILFORD, E.).—School, Golfe Road, for the borough E.C.; L. F. J. Reynolds, education architect (returnable deposit of £1 1s.). Town Hall extensions (£60,000), for the T.C.; borough surveyor.

(HACKNEY, E.).—Clearance and rehousing schemes; L.C.C. architect. Town Hall extension (£150,000); borough engineer. Factory, Wilton Road; J. Pritchard & Son.

LONDON (*Continued*).

(EAST HAM. E.).—Conversion of Palais de Danse, Wakefield Street, into cinema; J. R. Wilkins, architect.

(ELTHAM, S.E.).—Public library, Southwood and Foots Cray Roads (£13,000); borough engineer.

(GREENWICH, S.E.).—Infant welfare and artificial sunlight treatment centre, for the T.C.; borough engineer (returnable deposit of £2 2s.).

LOWESTOFT.—Extensions, Isolation Hospital (£6,833); borough engineer.

MAIDENHEAD.—School (600 places), North Town, for the Borough E.C.; H. E. Davies, clerk.

MANCHESTER.—Congregational Church, Parrswood Lane and Fog Lane; trustees. Business stores (£500,000), for Rylands, Ltd.; J. Gerrard & Sons, Ltd., builders, Swinton.

MANSFIELD.—Senior school (800 places), for the Borough E.C.; director of education.

NEWMARKET.—Housing scheme (54), for the R.D.C.; A. E. Austin, 4, Hills View, Great Shelford, Cambs. (returnable deposit of £1).

NORTHAMPTONSHIRE.—New schools and improvements, for the County Council E.C. (£55,300).

OLDHAM.—Administrative block, Strinesdale Hospital; borough engineer.

PLYMOUTH.—Houses (50), Glassmere Avenue; borough engineer.

PONTEFRACT.—New premises for King's School and adaptation of existing buildings for additional elementary school; Education Department.

PORTSMOUTH.—Additions, Royal Portsmouth Hospital, Commercial Road; the governors.

RAINHAM.—Child welfare centre and clinic, and 64 houses, for Gillingham T.C.; borough surveyor.

RAMSGATE.—Electric lighting installation, Haine Hospital, for the Isle of Thanet Joint Hospital Board; S. Shea, clerk, Cecil Square, Margate.

RICKMANSWORTH.—School, Croxley Green, for Herts, E.C.; C. E. Longmore, clerk, Hertford.

ROMFORD.—Houses (52), Park End Road, for Lawes, Cherry and Co.

RYDE.—Re-erection of portion of restaurant, Union Street, electrically equipped, for F. C. Young (£4,000).

SITTINGBOURNE.—Central business stores, for the Co-operative Society; Marshall Harvey, architect.

SOUTH SHIELDS.—Tenement houses (46), Hardings Bank, for Riverside Tenants Co.; J. H. Morton & Son, architects. Extensions, Mill Dam Quay (£25,000); borough engineer.

STOURBRIDGE.—Extensions, with engines, pumps, &c. (£17,890). for the Main Drainage Board; G. P. Deeley, engineer.

SUNDERLAND.—Extension of the borough mental asylum; Medical Officer for Health.

SUTTON BRIDGE.—Houses (20), Railway Lane, with electrical work, for the U.D.C.; C. P. Unwin.

SWANSEA.—Cinema, café and six shops, Picton Place; Picton Cinema Company. Aerodrome, Fairwood Common, Air Ministry and Corporation.

TILEHURST.—School, for Berks, E.C.; H. J. C. Neobard, clerk, Reading.

UPMINSTER.—Headquarters for Essex Territorial Army Association; H. R. Bird, architect, Brentwood (returnable deposit of £2 2s.).

WAKEFIELD.—Gymnasium at Thornes House School, for the City Council (£10,000); P. Morris, city architect, Town Hall.

WEST RIDING.—Technical institute, Barnoldswick; senior school, Syndale Road; extensions to Hemsworth Secondary School (£11,755); welfare centre clinic and clerks offices, Allan House; secondary school, Scawthorpe (£59,000); new school at Bentley (£48,500); and new blocks at two Bentley elementary schools (£9,000); Education Department, County Hall, Wakefield. Ten highway divisional offices (£10,000); county engineer.

WESTWOOD.—Mental hospital (£105,000); Bradford city architect.

WOLSTANTON.—Housing scheme (150), for the U.D.C.; surveyor.

WREXHAM.—Extensions, Technical Institute, with electrical and heating work (£25,869); Walter E. Hughes, Ltd., builders, Birkenhead.